

THREE ESSAYS ABOUT MONETARY POLICY IN CHINA

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Abstract

The thesis focuses on three aspects of China's monetary policy since the 1980s. Chapter 1 examines the monetary policy actions of the central bank in China. A new policy stance index incorporating a range of different monetary policy instruments is developed and examined. The empirical results suggest that the PBC is informally targeting inflation although no explicit target has been announced. Chapter 2 focuses on China's monetary conditions and aggregate demand in terms of the monetary conditions index (MCI). Different transmission channels are considered through which monetary conditions might influence aggregate demand. The empirical tests show that the MCIs contain useful information about future output growth and inflation in China over the short and medium term. Chapter 3 examines the fiscal challenges to the monetary authority's control over the price level in China. The empirical result suggests a fiscal dominance regime. When a pegged exchange rate regime is considered, it is argued that in the presence of large capital inflows and strong central bank interventions, the monetary authority can generate seigniorage without worrying about the foreign exchange reserves to decrease.

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INTRODUCTION

In practice, the monetary policy measures China has used for a similar purpose have varied substantially in different time periods since the 1980s. In the third quarter of 1988, the inflation based on the consumer price index (CPI) soared to 23.1 per cent. Frightened by inflation and other social unrest, the authorities immediately announced a stabilisation programme in September 1988. As the monetary policy was at the core of the programme, the People's Bank of China (PBC) raised both the lending rates and the deposit rates. Meanwhile, to curb the expansion of bank loans the PBC severely cut commercial banks' loans for fixed capital formation. Later in 1994, a further enormous rise in inflation hit China with the annual rate reaching 24.2 per cent. This time, the PBC did not increase interest rates; what it relied on was a strict control of the expansion of bank loans. In the third quarter of 2007, CPI inflation increased sharply to 6.1 per cent compared to 1.3 per cent a year earlier. To impose a tight rein on inflation, the PBC officially declared a switch of its monetary policy stance from a 'neutral' one to a 'moderately tight' one. Various monetary policy instruments were then employed, including ten rises in the reserve requirement ratio (RRR) amounting to a total of 5.5 per cent, and rises in the deposit and loan rates.

These examples of high inflation episodes in China and the subsequent uses of different monetary policy instruments by the PBC raise a fundamental question: how can we accurately describe the stance of the PBC's monetary policy? A good measure of the monetary policy stance should be able to tell us, either qualitatively or quantitatively, whether monetary policy is becoming contractionary, unchanged, or expansionary. As we have mentioned, however, the operating procedures of China's monetary authority have been changing dramatically over time. Therefore, focusing on one single policy instrument such as a specific interest rate (which is fairly conventional in the literature on monetary policy in advanced economies) is not enough for studying China's situation. To this end, Chapter 1 develops a comprehensive

measure of the monetary policy stance of the PBC which may be useful for both the PBC for policymaking purposes and researchers in an analytical sense. Moreover, the relationship between this policy stance index and China's economic developments is examined through different econometric approaches.

One feature of the policy stance index derived in Chapter 1 is that it takes account of all the central bank's monetary policy instruments at the same time. It is reasonable to infer that China's monetary policy affects aggregate demand through more than one transmission channel. Therefore, Chapter 2 aims to get a better understanding of how China's monetary policy determines aggregate demand and inflation. In particular, it focuses on the role of the monetary conditions which lie between the monetary policy actions and aggregate demand on the policy transmission channels. Conventionally, monetary conditions take account of the interest rate channel and the exchange rate channel. Since bank credit also plays a prominent role in China, taking into account the credit channel appears to be particularly desirable. In light of the existing multiple transmission channels of the monetary policy, Chapter 2 answers the following question: How can we fit those channels together to understand the effect of China's monetary policy?

Specifically, Chapter 2 develops a monetary conditions index (MCI) to provide convenient summary calculations of the overall changes in China's monetary conditions. The MCI is constructed by weighting the interest rate, the exchange rate, and bank credit by their relative impacts on aggregate demand. The variables which enter the MCI are carefully chosen, and the weights are derived from economic models. Both the choice of variables and their weights are particularly crucial in constructing the MCI. Once the MCIs are constructed, it is necessary to check if they are able to predict future economic conditions, i.e. the correlations of the MCI with future economic growth and inflation.

Chapter 1 and 2 are designed to provide a comprehensive understanding of China's monetary policy. The underlying discussion is mostly from the perspective of the monetary authority, with two implicit assumptions: first, the monetary policy plays an exclusive role in the stability of the economy; and second, the fiscal policy is constant over time. Those assumptions, however, may be less acceptable in an emerging economy like China in which the monetary authority has a less dominant role in the government. In 2008, China launched a large economic stimulus programme to drag the economy out of the shadow of the 2008 financial crisis. Since then, China's fiscal deficit exploded from 20.2 billion yuan in 2008 to 649.5 billion yuan in 2010, and the public debt increased rapidly. On the monetary side, the stock of broad money M2 almost doubled in nominal terms, while bank loans, subject to strong interventions by the PBC, jumped sharply from 30.3 trillion yuan to 47.9 trillion yuan. At the end of 2010, China's annual CPI inflation had risen to 4.7 per

cent compared to -0.6 per cent in the first quarter of 2009.

Given this background, Chapter 3 attempts to address the following issue: Is monetary policy influenced by fiscal policy in China? This issue is related to the concept of fiscal dominance (FD) and the fiscal theory of the price level (FTPL). The former refers to a condition in which fiscal policy is passively adjusted to satisfy the government budget constraint; the latter argues that if the government determines the primary surplus (tax revenues plus seigniorage, minus non-interest expenditures) without regard to the real liabilities, then the price level that has to adjust to balance the budget constraint. If there were a fiscal dominance regime in China, fiscal rather than monetary policy would provide the nominal anchor. In such a situation, any fiscal changes would impact the price level no matter how committed the PBC was to price stability. The conventional quantity theory of money would become less relevant, as attempts by the monetary authority to fix the money stock would end up causing fluctuations in inflation. Chapter 3 tries to identify the extent of fiscal dominance in China. It also discusses the role of fixed exchange rates in a FD regime in an open economy.

MEASURING THE MONETARY POLICY STANCE OF THE
PEOPLE'S BANK OF CHINA: *AN ORDERED PROBIT*
ANALYSIS

1.1 Introduction

As an important component of the framework of China's macroeconomic policy, the monetary policy operations of the People's Bank of China (PBC) have become of great concern to the rest of the world. One example is the disagreements over China's foreign exchange rate policy between China and its main trading partners such as the US and the EU since the 1990s, for which the value of the RMB is a cause for concern over cheaper and more competitive Chinese products. However, despite the growing literature on China's monetary policy, less attention has been paid to looking for an indicator which can accurately represent the stance of monetary policy. As Bernanke and Mihov (1998) indicate, measuring monetary policy accurately is important both to policy makers for practical reasons and to researchers for analytical reasons.

A good measure of the monetary policy stance should be able to tell us, either qualitatively or quantitatively, whether monetary policy is becoming contractionary, unchanged, or expansionary. Most current studies only focus on the link between the changes in a single policy instrument (or a single monetary indicator) and the macroeconomic situation in considering monetary policy stance. For example, in many studies the growth rate of broad money supply M2 is often used as an indicator to represent the PBC's monetary policy stance. By 2009, M2 was almost forty times higher than in 1990, with an average nominal annual growth rate over the period of 21.4 per cent per annum. Can we simply conclude, based on the fast growth rate of M2, that China has conducted an expansionary monetary policy throughout the past two decades? The answer is 'No', particularly when the PBC officially announced a

switch from a loose monetary policy towards fighting the battle against high inflation in 2007 and 2009.

One significant difference between the measure of policy stance used by Bernanke and Mihov (1998) and that of other studies is that they account for the federal funds rate, nonborrowed reserves and total reserves in their indicator of policy stance, because they argue that the Fed's operating procedure evolved substantially during the period of interest to them. This concern is particularly relevant for studies of the Chinese case. Given the rapid process of economic transition in China since the early 1980s, the operating procedures of the monetary authority have been changing dramatically over time as well. Thus, to measure policy stance accurately requires us to take into account a wider range of monetary policy instruments. To this end, the main contribution of this paper is the construction a new policy stance index for China between 1986Q4 and 2010Q3. Once such a measure is constructed, a monetary reaction function can then be used to identify the connection between this measure and the state of the economy. Instead of the standard OLS analysis, the main empirical results in this paper are obtained in the framework of an ordered probit approach.

In addition, to study the relationship between the monetary policy stance and the PBC's own interpretations of the state of the economy, we attempt to extract information on the PBC's assessment of the outlook from statements in the PBC's Quarterly Monetary Policy Executive Report since its first issue in 2001Q1. It seems that this is the first time such an exercise has been done for China. Given the less than transparent process of monetary policy making, we hope this approach may shed some light on China's monetary policy reactions and help us understand the making of monetary policy by the authorities.

The structure of this paper is as follows. Section 1.2 provides a review of the literature on the monetary policy stance, and the role of policy stance measures in examining monetary policy operations. Section 1.3 explains the construction of an index for measuring the change in the stance of monetary policy in China from 1986Q4 to 2010Q3. Section 1.4 presents some empirical results on the relationship between the policy index and key economic variables in an ordered probit model. We then examine the links between the policy index and the PBC's interpretations of the state of the economy between 2001Q1 and 2010Q3 as represented by some narrative indicator variables. Section 1.5 gives a summary of the chapter's findings.

1.2 Literature Review

In order to find the type of policy stance measure we need, various variables and approaches are reviewed in different studies. Initially, when some major central banks

focused on money supply growth in the 1970s and 1980s (the United States, Germany, the United Kingdom, Japan, etc.), a straightforward measure of the policy stance was the rate of growth of monetary aggregates (M1, M2 or the monetary base). Following this traditional measure, monetary policy strategies were explained through looking at monetary growth, in terms of either actual or targeted growth rates. Sims (1972) also uses the innovations to nominal M1 money supply as the measure of monetary policy. These so-called ‘innovations’ come from the disturbances in a VAR model, and are interpreted as unanticipated shocks to monetary policy. However, this simple and straightforward method is subject to some major criticisms. One of these argues that using this method to identify monetary policy has to assume that changes in money growth reflect changes only in money supply. But in practice, the monetary authority’s accommodation of shocks to money demand can also be reflected in the growth of monetary aggregates (Bernanke and Mihov, 1998). This kind of ‘non-policy influences’ on a monetary aggregate makes the growth rate not a suitable indicator as a measure of the stance of monetary policy. Another criticism, which is also a criticism of the targeting of monetary aggregates by central banks, is that there may be a weak or unstable relationship between the targeted monetary aggregate and the ultimate policy goal variable (inflation, nominal income, etc.). If that is the case, then focusing on the monetary aggregate (actual or targeted) makes no sense because the monetary aggregate will no longer provide adequate signals about the stance of monetary policy (Mishkin, 2010, p. 399).

When central banks turned to targeting inflation from the early 1990s, another strategy of measuring stance of monetary policy was proposed: to look at the interest rates. As central banks began to shift from monetary aggregates to several variables in their monetary policy decisions, this measure focused on changes in short-term interest rates, for example, the federal funds rate in the United States, the repo rate in the European Central Bank, and the Bank rate in the United Kingdom. An important feature of those interest rates is that they can be effectively influenced by the monetary authorities and can in turn affect various interest rates throughout the economy. One application of the use of the interest rate as a measure of policy stance is in the Taylor rule proposed by Taylor (1993). The Taylor rule indicates that the federal funds rate should respond to changes in price level and changes in real income, so the federal funds rate can then be regarded as an important indicator of the monetary policy stance. To further develop this measure by eliminating the endogenous response of the funds rate (the same criticism as that from which the monetary growth rate suffers) the innovations of the federal funds rate are then used to measure the Fed’s monetary policy stance. In addition, the federal funds rate, when compared with monetary growth, is a more informative variable with respect to future real economic variables such as income, consumption and employment

(Bernanke and Blinder, 1992; Christiano and Eichenbaum, 1992). Using the changes in the repo rate, Gerlach and Svensson (2002) and Gerlach (2004) measure the stance of monetary policy of the European Central Bank (ECB), where a 0.25 percent rise (cut) of the repo rate is considered as a small rise (cut), and a 0.5 percent rise (cut) as a large rise (cut) one.

Meanwhile, an additional measure of monetary policy stance, in the context of the United States after 1979, is the nonborrowed reserves (NBR) which are the reserves supplied by the Fed to banks through open market operations (Christiano and Eichenbaum, 1992; Christiano et al., 1996). An increase in NBR through the Fed's open market purchases increases the total supply of reserves, and can therefore cause the federal funds rate to fall. One remarkable feature of NBR is that it can be directly controlled by the Fed. So as with the federal funds rate, the innovations to NBR in a VAR model are also regarded as exogenous shocks to monetary policy. In addition, because NBR has a sharp and robust negative correlation with the federal funds rate it can also act as an information variable with respect to future real economic variables (Christiano and Eichenbaum, 1992). In an innovative paper, Bernanke and Mihov (1998) use both reserves and the federal funds rate in their measure of policy stance, in order to cope with the problem caused by the variations in the Fed's operating procedures over time. They incorporate total reserves, nonborrowed reserves and the federal funds rate as monetary policy variables in a structural VAR model. Then they take a linear combination of those policy shocks as the policy stance. This approach came to be commonly used in the literature, for example, in studies estimating monetary policy rules and evaluating monetary policy effects.

Among the criticisms of VAR-based approaches, a major one closely related to the stance of monetary policy argues that using residuals from the VAR to represent monetary policy shocks could be problematic (Rudebusch, 1998). For instance, one can also use federal funds futures (FFF) contracts which provide expectations about the federal funds rate. Exogenous policy shocks identified in this way are regarded as more market-derived policy shocks, but are quite different from those obtained from VAR-based approaches. Discrepancies between different estimates of policy shocks would then limit their usefulness as tools for analyzing economic history (Walsh, 2003, p. 33). Besides, another criticism of VAR-based measures of policy stance argues that this method only focuses on unanticipated monetary policy. However in practice, it is usually the anticipated monetary policy that is regarded as monetary policy, such as the response of the federal funds rate to output and inflation in the Taylor rule. So if one wants to characterize monetary policy as a feedback rule on the economy, then the VAR-based measure would conclude that monetary policy is not important at all (Walsh, 2003, p. 34).

In addition to quantity-based indicators of policy stance such as the monetary growth rate, the federal funds rate, and nonborrowed reserves, an alternative approach is also proposed, known as the narrative-based measure (Boschen and Mills, 1995; Romer and Romer, 1989). This method is based on the documents, statements and publications issued by the monetary authorities. Information is extracted in terms of integer numbers. For example, monetary policy can be identified on a range from strongly expansionary (marked as -2) to strongly contractionary ($+2$). But this approach is often criticized on the grounds that it depends on the subjectivity of the researcher who reads the documents and measures the policy (Bernanke and Mihov, 1998). Besides, one weakness of the narrative approach is that it might focus too heavily on the intentions of the monetary authorities, while their actual policy actions may diverge from their own intentions. If this is the case, then using policy intentions alone to measure the actual policy stance may produce a misleading result in the analysis of monetary policy reactions.

In the current literature on China's monetary policy, the monetary base growth rate, broad money supply growth rate and primary lending rate are three variables which are commonly used for measuring monetary policy in China. Firstly, as the PBC targets the monetary aggregates, they are often used as the measure of monetary policy (Burdekin and Siklos, 2008; Koivu, 2008; Xie and Luo, 2002). But as we have mentioned earlier, monetary base, M1 and M2 all reflect demand shocks as well as the PBC's policy stance. For example, the changes in monetary aggregates also reflect foreign capital inflows or export revenues. Since a part of the increased money is typically sterilized by the PBC, the relationship between the growth of broad money after sterilization operations and the PBC's policy actions remains complicated. The final policy effects depend critically on whether the central bank's sterilization operations are successful or not. In addition, the targets for broad money announced by the PBC may not be suitable as an indicator of the policy stance, as those targets are announced at an annual frequency and are not continuously adjusted to the state of the economy (He and Pauwels, 2008). In recent years, this targeted money growth rate seems to be rarely mentioned by the PBC.

Secondly, some studies use a VAR-based approach as a measure of policy stance in China (Koivu, 2008; Koźluk and Mehrotra, 2008; Laurens and Maino, 2007), but the criticisms by Rudebusch (1998) and Walsh (2003, p. 34) still apply to this approach in the context of China. On the other hand, there seems to be a consensus that the interest rate has a limited role in measuring monetary policy stance due to the segmentation of the credit market, the uncompleted restructuring of the banking system, and the insensitive response of firms and individuals to the price of capital. At the very least, changes in interest rates alone are not capable of representing fully the change in the PBC's monetary policy actions. Xie and Luo (2002) conduct empirical analysis using the Taylor rule in China and argue that it can provide a

benchmark for measuring the stance of monetary policy. But given the limitations of the interest rate as a monetary policy tool and the pegged exchange rate system at present, their conclusion seems to be less than convincing.

The work most closely related to our study is by He and Pauwels (2008) using an index-based approach. It is similar to the policy stance index constructed by Gerlach and Svensson (2002) and Gerlach (2004) but they incorporate more variables representing various monetary policy instruments. He and Pauwels take the discrete changes in the reserve requirement ratio, lending and deposit rates, and magnitudes of open market operations together to measure the monetary policy stance of the PBC from 1997 to 2007. In their so-called ‘policy index’ they assume that all the policy instruments share the same weight in determining the direction of the policy movement. He and Pauwels’s empirical results suggest that the monetary policy index can be well explained by the objectives of policy, especially the CPI inflation. Another study concerning the construction of a policy index is that by Huang and Lin (2006), who use a similar method for the central bank of Taiwan.

1.3 Constructing a Measure for the PBC’s Policy Stance: A Policy Change Index

An important function of our indicator of monetary policy stance is that it should reflect the movements of some important monetary policy instruments. Those instruments included should be controlled directly and effectively by the central bank, and should have a clear and stable relationship with the state of the economy. A remarkable feature of the PBC’s monetary policy, as mentioned earlier, is that the main monetary policy instruments on which the PBC depends have varied greatly over time. For instance, the credit plan was used as the main monetary policy instrument during most of the 1990s. But it was abandoned in 1998 and replaced by central bank refinancing to the commercial banks. Then from 2003 on, the PBC’s open market operations began to play an important role as a monetary policy instrument. Therefore, the variations in monetary policy instruments are an important element to be dealt with in constructing a policy index, and this necessitates separating the entire period into several different subperiods based on shifts between policy instruments.

A second key feature of the PBC’s policy implementation is that the PBC appears to prefer a combination of different monetary policy instruments in some periods. For example, from 2001 to 2002 both the central bank refinancing and open market operations via transactions of government bonds were used as important instruments, while the latter were aimed at sterilizing the increased liquidity caused by trade surpluses and foreign direct investments (FDI). Then during 2006–07 the

reserve requirement ratio and open market operations were frequently used together by the PBC to absorb the excessive liquidity.

Consequently, given the inherent limitations of each monetary policy instrument alone as a measure of the policy stance, as well as the characteristics of the PBC's monetary policy operations, it would be useful to develop an indicator of the monetary policy stance which is capable of capturing as much information on monetary policy actions as possible. One plausible way to do this is to consider the movements of all the important monetary policy instruments in measuring the PBC's policy stance. The details of constructing such an index are discussed in the rest of this section.

1.3.1 Main policy instruments in the policy change index

As mentioned earlier, the PBC has been relying on different policy instruments over time, so we start by identifying the set of main monetary policy instruments from 1986Q4 to 2010Q4. Presumably, the changes in those policy instruments together can sufficiently signal the policy stance of the PBC within the periods when such policy actions were observed. The policy instruments considered in the policy index of different periods are reported in Table 1.1.

Period	Main monetary policy instruments
1986Q1–1997Q4	1. Credit plan for banks' lending; 2. Various interest rates.
1998Q1–2002Q3	1. Central bank's refinancing to banks; 2. Various interest rates; 3. Reserve requirement ratio.
2002Q4–2010Q4	1. Open market operations (central bank securities); 2. Various interest rates; 3. Reserve requirement ratio.

Table 1.1: Main monetary policy instruments: 1986Q1–2010Q4

Before 1998 the credit plan was the PBC's main instrument for controlling credit and money supply. During the first subperiod, the PBC could theoretically control the money supply by imposing credit controls on banks' lending according to the credit plan. Since bank financing was the only source of finance available to the public during that time, it is reasonable to suppose that changes in bank credit reflected the credit plan which was used as the main policy instrument during this period. It is often argued, however, that credit quotas under the credit plan were usually exceeded by State banks' excessive credit creation, which made the credit plan less credible as a policy instrument. Due to strong economic growth and the very low cost of capital, the aggregate demand for capital by firms, farmers and government

agencies was far beyond the credit quotas and the banks had to provide excess credit under political pressure from local governments (Guo, 2002, p. 38). So the credit plan alone may not be enough to measure the policy stance. Therefore, we incorporate another conventional policy tool in our policy index besides the credit plan: the changes in various interest rates,¹ which were under a strict administrative control from the PBC. In order to eliminate the excess demand for capital, the interest rate tool was occasionally used by the PBC where an interest rate rise could increase the cost paid by borrowers. Although in fact the PBC depended less on the interest rate tools during that time, changes in interest rates could be treated as signals sent by the PBC on its policy intentions. For the same reason, changes in interest rates are considered in the policy index throughout the overall sample period. Secondly, the direct lending from the PBC to the commercial banks became a main policy instrument during the subperiod from 1998Q1 to 2002Q3. In order to measure the magnitude of the direct lending by the PBC, we look at the credit from the PBC to the banks. This item reflects the standing facilities where liquidities are provided by the PBC to the commercial banks and other depository institutions. It consists of two parts: the central bank refinancing and the discount facilities, of which the refinancing volume and the discount rate can be determined by the PBC. At the same time, as the reserve requirement ratio (RRR) was introduced in 1998, the changes in this ratio are also considered in the construction of the policy index. Then from 2003 open market operations (OMOs), which are considered a more market-based policy instrument, were frequently used as one of the PBC's monetary policy instruments. The PBC began to issue central bank bills as the main OMOs instrument, which is used for sterilization operations related to interventions in the foreign exchange market. As in the second subperiod, there are three instruments used to determine the direction of the monetary policy movements in the third period: OMOs, interest rates, and RRR.

It is noteworthy that, although those three subperiods in Table 1.1 reflect the evolution of the policy instruments which the PBC relies on over time, it is actually quite a rough sketch in which the subperiods are not completely clear cut. This sketch may cause the problem of an under-identification of the policy stance. For example, although the abandonment of the credit plan was officially announced in 1998, it is argued that credit control by the PBC still plays an important role in the second and third subperiod. In other words, changes in credit growth may still signal changes in policy stance after 1998. Similarly, due to the low transparency of the PBC's monetary policy making, we are not clear when the instrument of refinancing to banks became less important in the PBC's consideration. The main reason it does not appear in the third subperiod is that its outstanding amount

¹The various interest rates we look at include: primary lending rate, one year deposit rate, bank rate, rediscount rate and relending rates (of 20 days, 3 months, 6 months and one year).

began to decline substantially since 2002Q3. In order to reduce the possibility of losing any instruments which may still matter, we tend to construct two policy indices. The first index accounts for the evolution of the PBC's policy instruments divided subjectively as in Table 1.1; which works as the benchmark indicator of policy stance in our analysis. The second index, mainly constructed for comparison purposes, includes all instruments in Table 1.1 over time, regardless of the evolution of policy instruments.

1.3.2 Constructing the policy change index

In order to construct an overall policy change index, we need first to identify the change in each policy instrument variable included in the index. Following most of the literature which uses the index approach to measure monetary policy stance (Bernanke and Blinder, 1992; Christiano and Eichenbaum, 1992; Gerlach, 2004; Gerlach and Svensson, 2002; He and Pauwels, 2008), we define the change in the monetary policy instrument in terms of a triple-choice set: -1 , 0 , and 1 indicate an expansionary change, no change, and a contractionary change in the policy actions, respectively.

Next, we need to establish some criteria or thresholds for these changes. For the rate-based instrument variables, like interest rates and reserve requirement ratio, the directions of their changes can be used to identify the stance of policy. For instance, an interest rate rise, or an increase in the reserve requirement ratio, can be regarded as a tightening policy stance. For the quantity-based variables like credit growth, the PBC's refinancing to banks and OMOs through central bank bills, we need to employ other methods which seem a bit subjective and artificial.

For the two policy variables, domestic credit and PBC's refinancing, we first apply the Hodrick-Prescott (HP) filter to the four-quarter-change series, i.e. the change relative to the same quarter of the previous year. We use this approach because we want to remove the long-term trends and extract the cyclical fluctuations. This is a common method used in the examination of macroeconomic time series. The smoothing parameter λ is set at 1600 for the quarterly data. Secondly, we adopt an arbitrary criterion to the cyclical component which reflects the short-term fluctuation around zero: any cyclical component that falls out of the range of one standard deviation above (below) the long-term trend is regarded as a large deviation. Such a growth rate is then identified as a looser (tighter) policy stance. Otherwise, it is identified as an unchanged one.

To measure the OMOs by the PBC, another quantity-based policy variable, we look at the net change in the outstanding amount of the central bank bills at the end of each quarter. We do not use the percentage change because the series contains

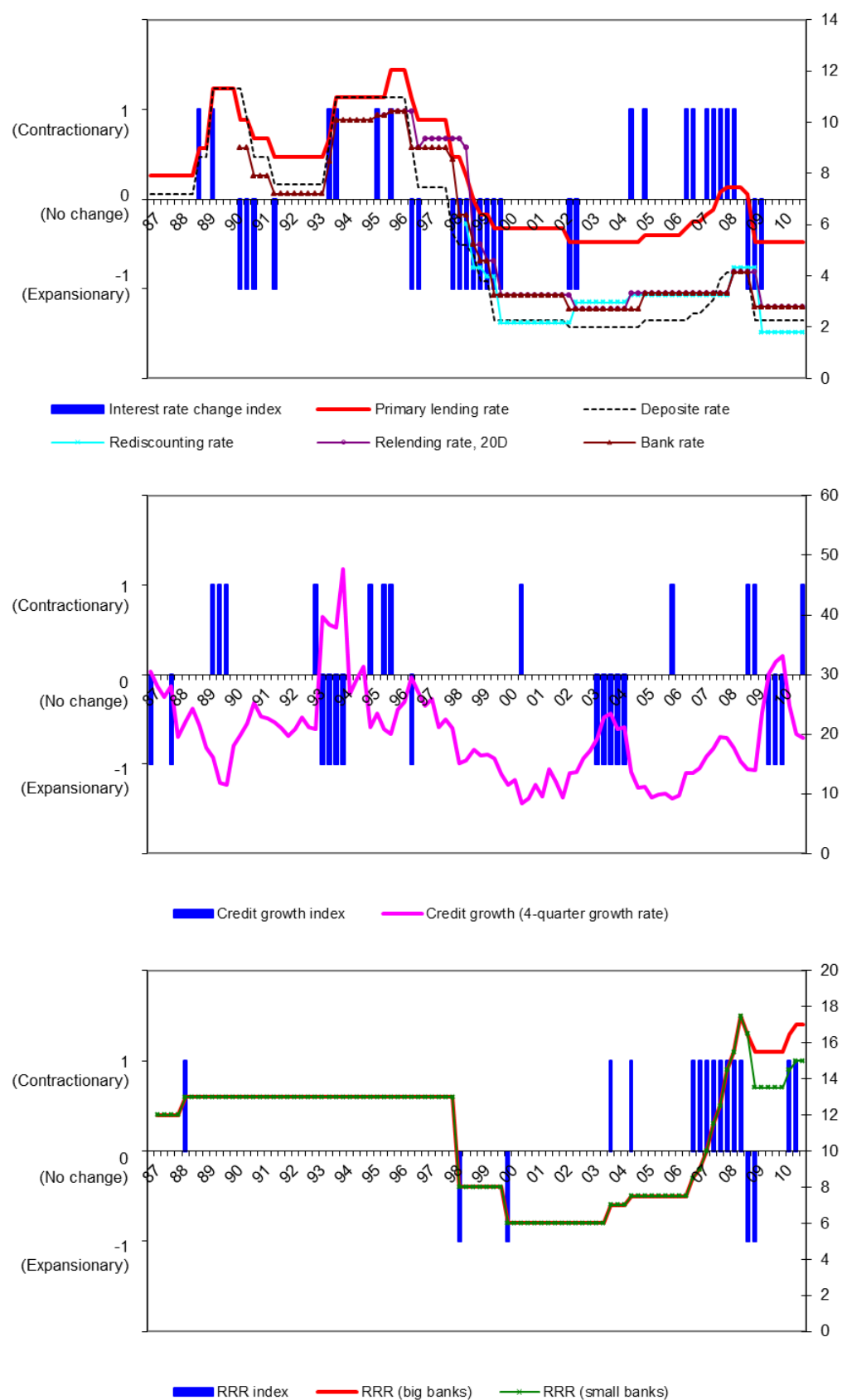


Figure 1.1: Five policy instrument indices

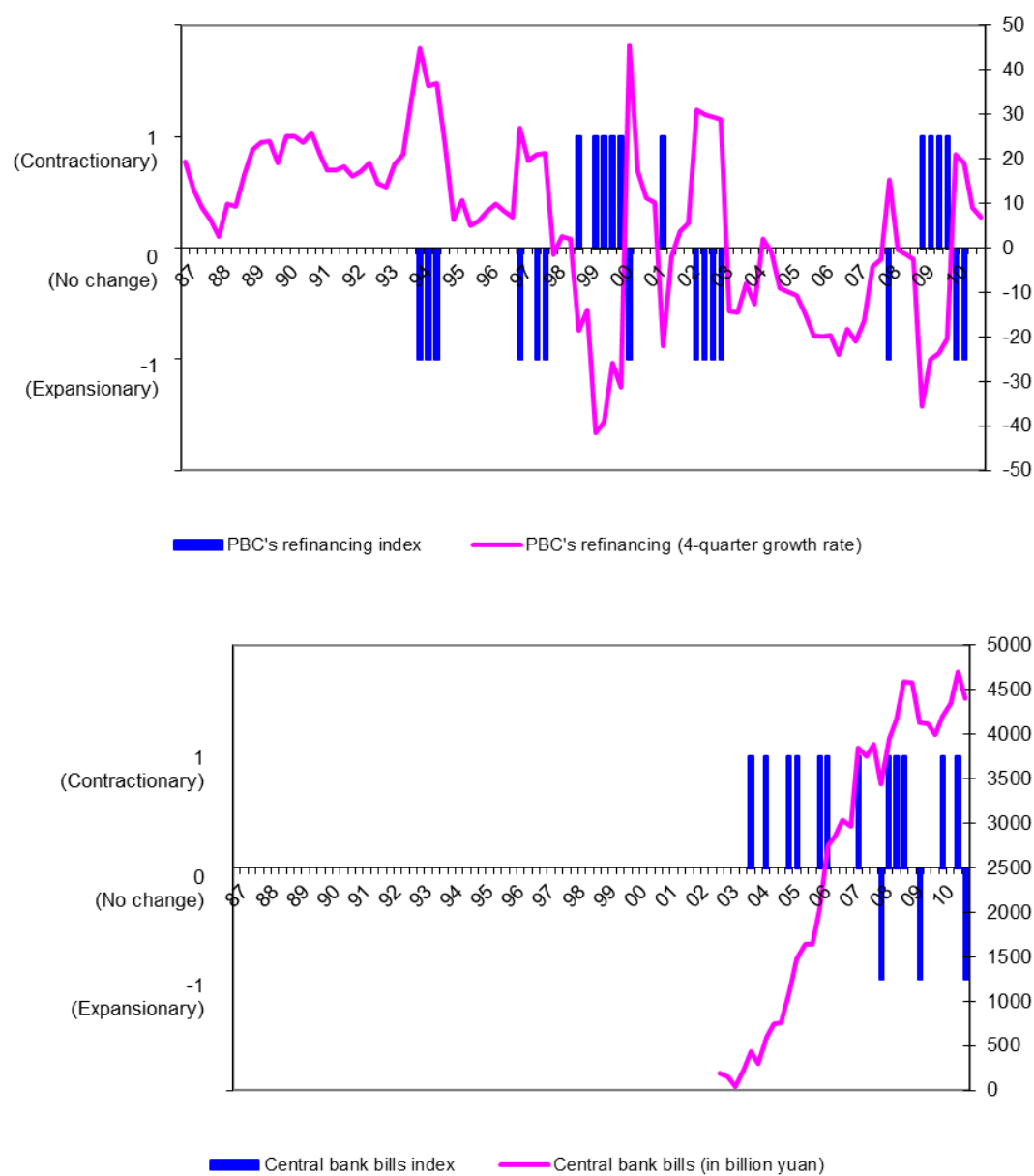


Figure 1.1: Five policy instrument indices

too many fluctuations in terms of percentage changes. For example, there is usually a small change followed by a large change, or a negative change followed by a positive change. So a quantitative criterion is proposed: if a net injection (withdrawal) of central bank bills is larger than 200 billion yuan, the change is regarded as a large one, and the corresponding policy stance is then identified as looser (tighter). According to the calculation by He and Pauwels (2008) who use a similar criterion, OMOs of 200 billion is roughly equivalent to a change in the reserve requirement ratio of 0.5 percent. This band of 0.5 percent is a typical range for the reserve requirement ratio change at a time. So this criterion is a reasonable way to balance the risk of over-identifying and under-identifying when changes in open market operations truly signal changes in policy stance. Based on all the criteria mentioned so far, Figure 1.1 shows the indices of all five policy instruments over time: various interest rates, credit growth, RRR, PBC's refinancing, and PBC's OMOs through central bank bills. For the purpose of comparison, the actual value of those policy instrument variables is also reported in each corresponding figure.

Once we obtain all the observed changes in the policy instrument variables of interest, the overall policy change index can then be inferred. Like the individual index of each policy instrument variable, we define the overall change in monetary policy stance in terms of a triple-choice set, where PCI_t denotes the policy change index; and the values -1 , 0 , and 1 indicate an expansionary change, no change, and a contractionary change in the policy stance, respectively.

$$PCI_t = \begin{cases} -1, & \text{if there is an expansionary change;} \\ 0, & \text{if there is no change;} \\ 1, & \text{if there is a contractionary change.} \end{cases} \quad (1.1)$$

Considering the variation of policy instruments used by the PBC, the way we construct the benchmark overall policy change index is straightforward: if a change in the specific policy instrument is observed, the monetary policy stance is identified in the same direction. For example, in 1986Q4 when the credit growth is identified as -1 while the interest rate was unchanged, PCI_t is identified as -1 ; in 1997Q4 although credit growth index was unchanged this time, PCI_t is identified as -1 because the primary lending rate, deposit rate and bank rate were cut by 1.44, 1.8 and 0.45 points respectively.

Since more than one policy instrument has been incorporated in the policy change index, it is inevitable that the policy instruments sometimes move in opposite directions to each other. In fact, it happens nine times throughout the entire sample period. In order to address this confusion caused by conflicting signs we simply assume that each policy instrument index in certain subperiod shares the same weight. So if two different signs are observed at the same time, they would offset each other,

leaving no change in the overall monetary policy stance. For instance in 1998Q3 and 1999Q2, while the PBC reduced central bank refinancing by 18.4 percent and 25.8 percent respectively, various interest rates were also cut. The latter is typically regarded as a signal of expansionary monetary policy. So we treat these two cases as no change in the policy stance. When three policy instruments are considered in subperiod 2 and 3 in Table 1.1, if they do not move in the same direction, since they are assumed to have the same importance, the policy stance depends on the direction of the majority of changes. For instance, in 2007Q4 and 2008Q3 the policy change index is determined jointly by interest rate index and required reserve ratio, although there was an opposite direction suggested by PBC's OMOs.² By consolidating all the policy instrument indices we plot the overall policy change index in Figure 1.2 for the whole sample period from 1986Q4 to 2010Q3.³

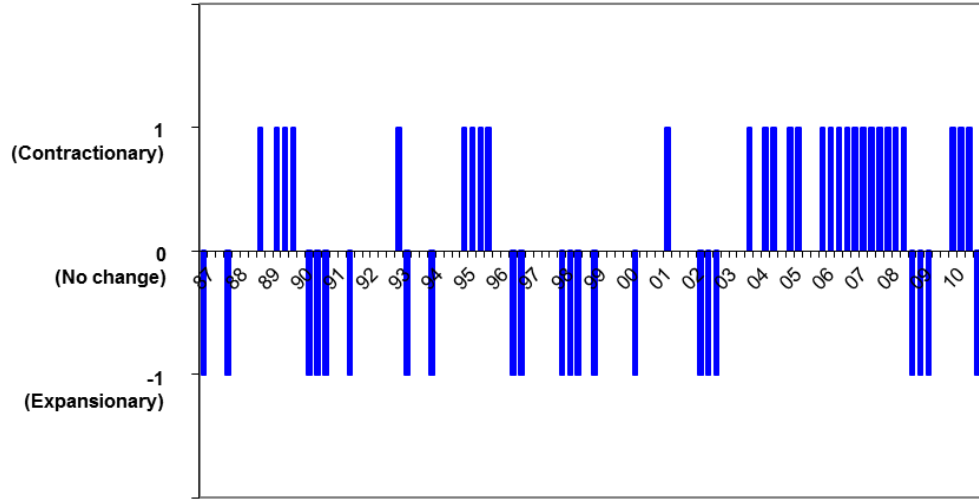
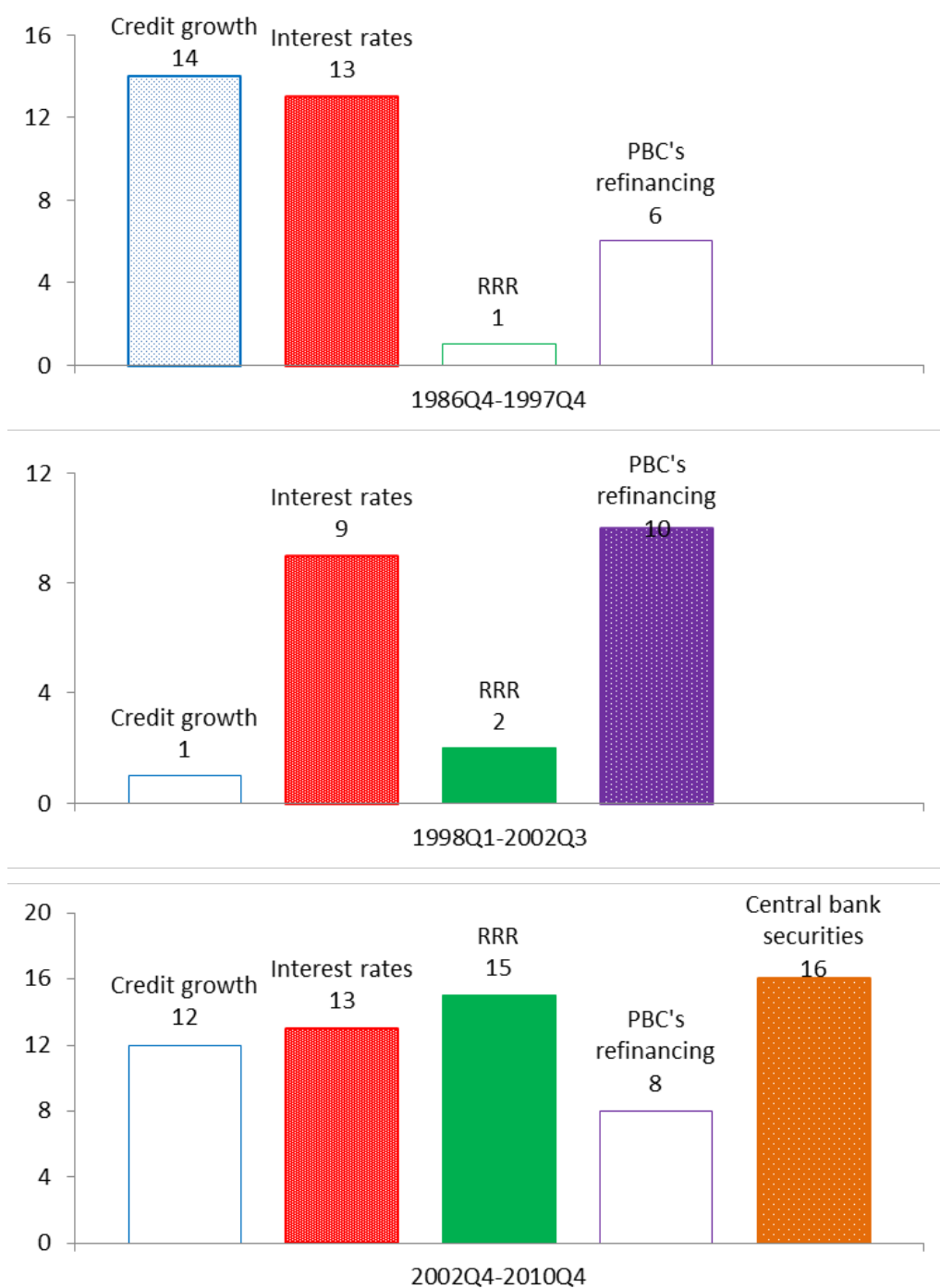


Figure 1.2: Policy change index: 1986Q4–2010Q3 (benchmark index)

In order to look at the individual contribution of each policy instrument to the overall policy stance index, we plot the numbers of relevant identified changes of monetary policy instrument variables in Figure 1.3. According to Table 1.1, the entire sample period is divided into three subperiods. It can be seen that firstly, the phases of monetary policy described in Table 1.1 are reasonable, as the policy instruments we choose to include in the policy change index generally dominate the monetary policy actions in each subperiod. Secondly, interest rate changes contribute significantly to the final policy change index in each subperiod; however, it changes

²This majority rule also applies to the identification of the alternative policy index, which accounts for all major policy instruments for the entire sample period, noted as $PCI_{all,t}$.

³We also plot the alternative policy change index in Appendix A, which does not take account of the evolution in the PBC's use of different policy instruments over time. Roughly speaking, the two graphs look similar to each other, with no significant differences. The benchmark policy change index reports fewer changes (41 changes) than the alternative index does (49 changes). In the rest of the chapter we use the benchmark index in our analysis.



Note: In each subperiod, the bars without shadows denote policy instruments that are not accounted for in the policy change index, see Table 1.1.

Figure 1.3: Contributions of individual policy instruments to the policy change index

less frequently than other policy instruments of concern over time. Thirdly, given the considerable number of changes, the RRR is increasingly important in providing signals of policy stance changes. Finally, besides the RRR, the PBC relies heavily on the central bank bills in the third period when it has confronted the soaring foreign exchange reserves since 2003.

1.3.3 A historical review based on the policy change index

From a historical perspective, the policy change index shown in Figure 1.1 generally captures most of the important changes in the stance of the PBC's monetary policy. For example, in January 1991 a new round of foreign trade reform was announced which ended all fiscal subsidies on export losses (Liew and Wu, 2007, p. 77). So the expansionary policy change represented by the interest rate cut may be understood as a measure to support this reform by reducing the financial costs of export enterprises. In 1992–93, an investment fever was stimulated by the central government. On the other hand, the CPI inflation rose sharply, and the central government and the PBC decided quickly to fight the inflation and financial disorders. Interest rates were increased, and administrative controls including credit controls, business restrictions by local governments and foreign exchange rate controls, were imposed by the State Planning Commission.

In January 1994, the unification of the RMB official rate and market rate led to a devaluation of the Chinese currency. A substantial increase in domestic money supply was observed. Since then the rapid increase in money supply may explain an observed tightening in the policy stance in 1995 in terms of a significant reduction in the growth of credit supplied by the banking system. After the Asian Financial Crisis in 1997, China faced a continuously weak domestic demand as well as currency appreciation. The expansionary monetary policy played an active role in boosting domestic demand.

As in 1994, it is believed that the contractionary policy stance of 2000 and 2001 was due to a strong financial inflow caused by an increasing interest rate spread between China and the US, and the expectation that the Chinese currency would be revalued (Eichengreen, 2004). In order to curb the surge in liquidity the PBC began to issue central bank bills for sterilization purposes from the third quarter of 2002. In 2007 signs of overheating emerged with CPI inflation rising sharply and GDP growth rose to 12.2 percent in the first half of 2007. In 2007Q3 the PBC declared a switch of the monetary policy stance from a 'neutral' one to 'moderately tight', and later to a 'tight' one. Various monetary policy instruments were used, including ten rises in the reserve requirement ratio amounting to a total of 5.5 percent, and rises in the one year deposit and loan rates by 1.62 and 1.35 percent respectively.

According to the policy change index, such a tightening of policy can be observed from the end of 2004. In 2008Q3, due to the negative impacts of the international financial crisis and domestic natural disasters, the PBC announced a 'moderately loose' monetary policy to stimulate economic growth. This policy decision explains the drop in the policy change index at the end of 2008. However at the end of 2009 when a new round of inflationary pressure emerged following the monetary looseness

and fiscal stimulus, the officially announced monetary policy stance shifted from proactive to prudent.

Outcome	Count	Percent
−1	22	22.7
0	45	46.4
1	30	30.9
All	97	100.0

Table 1.2: Frequencies of the policy change index: 1986Q4–2010Q3 (benchmark index)

Some interesting patterns of the policy changes may be inferred from Table 1.2 which presents the frequencies of the three policy changes. In 45 out of the total 97 quarters, the monetary policy stance is identified as 0 (unchanged). This is consistent with the fact that the PBC prefers officially to describe its monetary policy as prudent (perhaps a no-change policy is the closest to this so-called prudent policy). In 30 quarters monetary policy was contractionary. Only in 22 quarters was there an expansionary change in policy stance, and these changes tended to concentrate in the years of economic turmoil such as 1990, 1997–2001, and 2008. The relatively lower frequency of an expansionary policy stance compared to the other two categories may not be surprising, as in China a pro-active fiscal policy, which has been implemented in most years since the 1980s, is regarded as having a more important role for rapid economic growth.

To sum up, the policy change index constructed in this section appears to capture well the important changes in monetary policy. An empirical analysis of our policy change index will be given in the next section in the framework of an ordered probit method.

1.4 The PBC’s Reaction Function Using the Policy Change Index: An Ordered Probit Method

The policy change index constructed in Section 1.3 provides a general description of the PBC’s policy stance with a rating from contractionary to expansionary. Furthermore, it can help us to explore the connection between changes in policy stance and changes in the state of the economy, i.e. the policy reaction function of the PBC. In this section we pay close attention to the following question: when making policy decisions, is the PBC responsive to output, monetary growth, inflation or the exchange rate?

However, our policy change index cannot be modelled as a dependent variable through conventional estimation methods such as the OLS method, because it is

discrete, in a certain order, and has limited values. In addition, the spacing of the index is not assumed to be uniform. For example, the difference between the index of -1 and 0 , can not be treated as the same as that between 0 and 1 . Fortunately, these problems can be addressed in the framework of the ordered choice approach. If the random term of the model is supposed to have a normal distribution, it is known as an ordered probit model.⁴ It is widely used in the econometric analysis of social science issues such as the decision to vote in an election, labour force participation, job classification and consumers' satisfaction levels from shopping experiences, and so on.

There are some applications of the ordered probit approach to monetary policy reaction functions (Eichengreen et al., 1985; Gerlach, 2004; He and Pauwels, 2008). Generally, those studies set the monetary policy stance variable as the dependent variable, depending on a vector of predetermined macroeconomic variables. In this section, we describe this kind of model specification, the data, and methods used in the econometric analysis of the PBC's policy during 1986Q4–2010Q3. Our empirical results suggest an important role of real output growth in the PBC's monetary reaction function.

1.4.1 *The model*

Our analysis is based on the studies by Gerlach (2004) and He and Pauwels (2008). Suppose the PBC's preferred monetary policy is determined by the function:

$$PCI_t^* = \hat{\mathbf{a}}' \mathbf{x}_{t-1} + \alpha ACCPCI_{t-1} + \epsilon_t \quad (1.2)$$

where PCI_t^* is a latent variable representing a preferred monetary policy change by the PBC in terms of the policy change index; \mathbf{x}_{t-1} is a set of observed macroeconomic variables with a one period lag; $\hat{\mathbf{a}}$ is the parameter vector; ϵ_t is the residual term which is assumed to be normally distributed. This suggests that the PBC's preferred policy stance can be specified as a linear function of certain macroeconomic variables. The role of this preferred policy stance is similar to the desired target policy rate in Taylor-type monetary reaction functions, where the policy rate is believed to react to the changes in the lagged economic environment \mathbf{x}_{t-1} . The variables entering \mathbf{x}_{t-1} upon which PCI_t^* depends are the real GDP growth rate (GDP) and the inflation rate (CPI). Since the PBC is targeting a monetary aggregate, the growth rate of the money supply ($M1$) enters as well. Due to the important role of the foreign exchange rate in the framework of the PBC's monetary policy, the change in the nominal effective exchange rate ($NEER$) enters as an indicator of external

⁴If the random term follows a logistic distribution, the model is called the logit model, which has been used for modeling purposes for several decades. See Greene and Hensher (2010, pp. 13–14).

conditions. Note that the independent variables entered in the reaction function so far are all in terms of percentage changes.

It is noteworthy that, according to our definition, PCI_t^* in equation (1.2) only describes the changes in monetary policy. In other words, it can be regarded as the ‘first difference’ of the PBC’s monetary policy stance. Since the PBC may also be concerned with the ‘level’ of its policy, we enter the accumulated value of PCI_t as a separate variable. Such an accumulated policy change, noted as $ACCPCI$, provides an overall measure of the monetary policy level. The intuition behind this accumulated change variable is straightforward. Suppose when controlling for all the other macroeconomic variables in \mathbf{x}_{t-1} that the previous monetary policy has already been tightened to a great extent (that is, there is a high level of $ACCPCI_{t-1}$): in this case the central bank may be less likely to implement the same tightening policy in the following quarter. In other words, the same value of macro variables may have different implications, depending on the overall level of monetary policy in the previous period. For example, the accumulated expansionary policy from 1997 to 2002, and the accumulated contractionary policy from 2006 to 2007, as shown in Figure 1.4, may have certain implications for the subsequent policy actions. So the role of $ACCPCI$ is quite similar to that of the Bank Rate in the model of Eichengreen et al. (1985) who set the change in the Bank Rate as dependent variable.

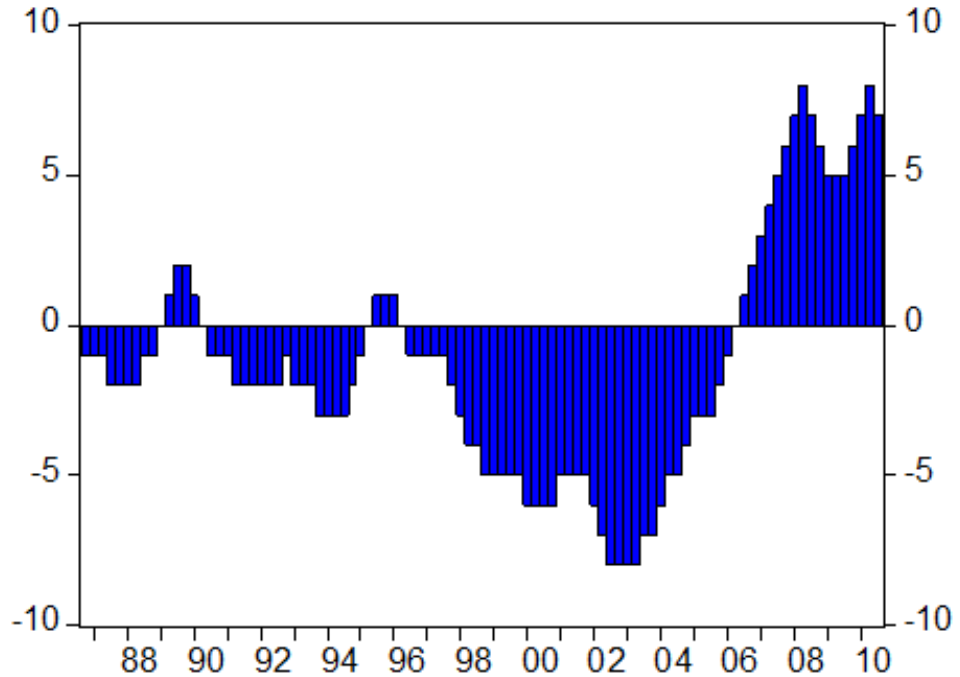


Figure 1.4: Accumulated policy change index (benchmark index)

Equation (1.2) is used as the benchmark model in our analysis. In some applications, equation (1.2) has also been derived as a function with a set of policy targets as

arguments, where the monetary policy respond to the deviation of variables in \mathbf{x}_{t-1} from the authority's targeted or preferred values. These targeted values are obtained either from the authority's explicit announcements, or by econometric approaches such as the Hodrick-Prescott filter or the Kalman filter. However, we have doubts as to whether it is appropriate to model the PBC's monetary policy with respect to some official targets for inflation or money growth, given that these targets are not announced on a frequent basis and often remain unchanged for several years. Moreover, those targets usually have a low credibility, for example, it is common to see the targeted money supply growth being overshoot considerably at the year end. Alternatively, we examine whether PCI_t^* responds to the divergence of the variables in \mathbf{x}_{t-1} from some econometrically 'preferred' levels. So we use the Hodrick-Prescott filter approach, take the cyclical components as a proxy of this divergence from the PBC's preferred level, and report these results for comparison reasons.

As a matter of fact, the low transparency of the PBC's policy making process makes it almost impossible to observe this preferred policy change, PCI_t^* . In addition, the actual monetary policy remains unchanged in some periods even though there is a considerable change in macroeconomic conditions. To explore this relationship between the discrete monetary policy change and the continuous economic situation via an unobservable, preferred policy change, we define the actually observed changes in policy stance, PCI_t

$$PCI_t = \begin{cases} -1 & \text{if } PCI_t^* \leq \gamma_1 \\ 0 & \text{if } \gamma_1 \leq PCI_t^* \leq \gamma_2 \\ 1 & \text{if } \gamma_2 \leq PCI_t^* \end{cases} \quad (1.3)$$

It is worth noting that the numbers of -1 , 0 , 1 representing the policy stance are totally arbitrary, they are just labels for different categories. γ_1 and γ_2 are unknown cut-off points, or thresholds, which define the ranges of the latent variable PCI_t^* . In other words, given the ordered choice of the policy change index, the authorities are forced to choose the category of PCI_t that most closely represents their own intentions for monetary policy, PCI_t^* . According to equation (1.2), we believe that the set of macroeconomic variables in vector \mathbf{x}_{t-1} can explain the observed policy decision made by the PBC. Under the assumption of normality, the probabilities of the observed policy changes are attached to \mathbf{x}_{t-1} , $\hat{\mathbf{a}}$, α , ϵ_t and γ :

$$\begin{aligned} \text{Prob} \left(PCI_t = -1 \middle| \mathbf{x}_{t-1}, \hat{\mathbf{a}}, \alpha, \epsilon_t \right) &= \Phi(\gamma_1 - \hat{\mathbf{a}}' \mathbf{x}_{t-1} - \alpha ACC PCI_{t-1}) \\ \text{Prob} \left(PCI_t = 0 \middle| \mathbf{x}_{t-1}, \hat{\mathbf{a}}, \alpha, \epsilon_t \right) &= \Phi(\gamma_2 - \hat{\mathbf{a}}' \mathbf{x}_{t-1} - \alpha ACC PCI_{t-1}) \\ &\quad - \Phi(\gamma_1 - \hat{\mathbf{a}}' \mathbf{x}_{t-1} - \alpha ACC PCI_{t-1}) \\ \text{Prob} \left(PCI_t = 1 \middle| \mathbf{x}_{t-1}, \hat{\mathbf{a}}, \alpha, \epsilon_t \right) &= 1 - \Phi(\gamma_2 - \hat{\mathbf{a}}' \mathbf{x}_{t-1} - \alpha ACC PCI_{t-1}) \end{aligned} \quad (1.4)$$

where Φ is a normal distribution cumulative function. The structure of equation (1.4) provides the framework for an econometric model of how the monetary policy stance changes. Estimation of parameters $\hat{\mathbf{a}}$, α , γ_1 and γ_2 is based on maximum likelihood estimation. These estimations can be conveniently carried out in econometric software packages such as *EViews*, and *Stata*.

1.4.2 Variables and data

In Table 1.3 we present summary descriptions of the variables used in estimation, and the sources of the data.

Variable	Definition	Source
<i>GDP</i>	4-quarter change in real GDP	Abeyasinghe and Rajaguru (2004); National Bureau of Statistics, China
<i>CPI</i>	4-quarter change in consumer price index	National Bureau of Statistics, China
<i>M1</i>	4-quarter change in nominal M1 money supply	People's Bank of China (PBC)
<i>NEER</i>	4-quarter change in nominal effective exchange rate	International Financial Statistics (IFS)
<i>ACCPCI</i>	Accumulated policy change index	Author's calculation

Table 1.3: Definition and data sources of variables

The quarterly observations for all variables from 1986Q4 to 2010Q3 are used. The four-quarter percentage change in real GDP growth, CPI inflation and M1 are adopted as the regressors to represent real output, inflation and aggregate money supply, respectively. The data for the quarterly real GDP growth rate are not available before 2000. We use the data derived by Abeyasinghe and Rajaguru (2004) who apply the Chow-Lin method to interpolate China's annual real GDP growth rate, based on the quarterly growth rate of money supply and external trade.⁵ M1 is used rather than M2 because the former covers a longer period while the latter is only available after 1996. The nominal effective exchange rate (NEER) is used to reflect the PBC's foreign exchange policy in terms of a 4-quarter percentage change.⁶ All the series are plotted in Figure 1.5.

One potential issue is the multicollinearity among variables in \mathbf{x}_{t-1} . Gerlach (2004) indicates in his study of the European Central Bank that if two variables

⁵For more details of the interpolation see Abeyasinghe and Rajaguru (2004).

⁶The nominal effective exchange rate (NEER) is a weighted average of the nominal exchange rates of home with respect to a set of foreign currencies with the weight for each foreign country equal to its share in trade. A higher NEER means that the purchasing power of the currency is higher; if NEER decreases, the domestic currency depreciates against its trading partners.

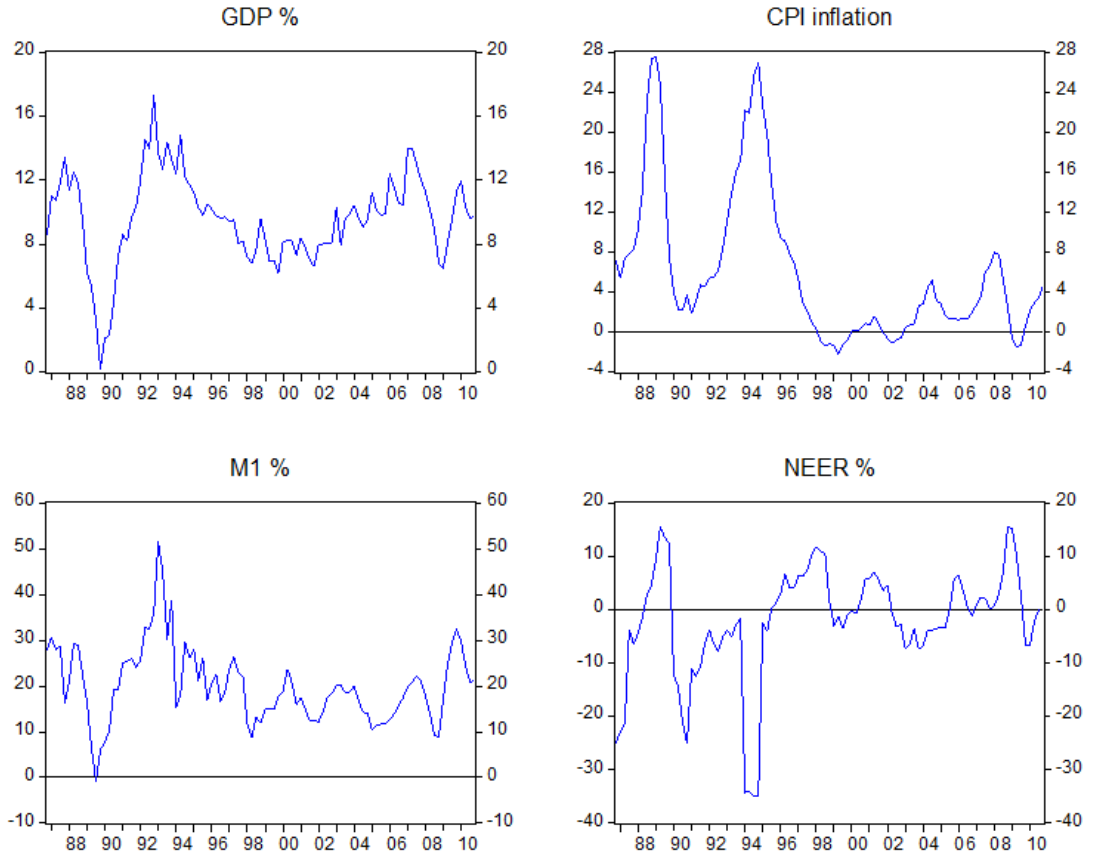


Figure 1.5: Variables used in estimation

	<i>GDP</i>	<i>CPI</i>	<i>M1</i>	<i>NEER</i>
<i>GDP</i>	1.0000	—	—	—
<i>CPI</i>	0.2784	1.0000	—	—
<i>M1</i>	0.6180	0.2565	1.0000	—
<i>NEER</i>	-0.2881	-0.2769	-0.3317	1.0000

Table 1.4: Correlations among variables in \mathbf{x}_{t-1}

evolve in a similar way over time, it is possible that the parameter estimates are subject to the problem of multicollinearity. However, the correlations among all the independent variables except *ACCPCI* in Table 1.4 provide little evidence of multicollinearity. Therefore, it will not be considered in our model in the following analysis.

1.4.3 Some empirical results

The results of the estimation using the maximum likelihood procedure are shown in Table 1.5. Regression 4.1 is our benchmark regression using the data described

in Table 1.3; while regression 4.2 considers the deviations of the variables in Table 1.3 (other than *ACCPCI*) from their long-term trend on the basis of the HP filter. All the independent variables are lagged by one quarter. Interestingly, in the first column of Table 1.5 none of the parameters on *CPI*, *M1*, *NEER*, and *ACCPCI* are significant. The only significant parameter is that on *GDP*, at the 1 per cent significance level. In regression 4.2, it is the parameter on *CPI* that is the only (but highly) significant one; while the parameter on *GDP* becomes insignificant. The threshold parameters, γ_1 and γ_2 , are necessary for the computations but of no intrinsic interest of their own, so we will not discuss them here.

Other diagnostic statistics are as follows. The *pseudo R*², also known as McFadden’s likelihood ratio, is used as a goodness of fit measure. Regression 4.2 has a larger *pseudo R*² compared with regression 4.1. Two characteristics of the *pseudo R*² should be noted: first, the *pseudo R*² has no connection to the proportion of variation explained; second, the value of *pseudo R*² increases when the model increases in size.⁷ The values of the *pseudo R*², at 0.06 and 0.13, are relatively low which may suggest a low fit. However, it is quite common to have a low *pseudo R*² in ordered probit analysis. For example, Gerlach (2004) reports some values of *pseudo R*² as low as 0.26 in his estimation. The *LR statistic* (likelihood-ratio chi-squared) is for the test of the null hypothesis that all of the coefficients associated with independent variables are simultaneously equal to zero. The *p*-value is indicated by *Prob (LR statistic)*, as in both regressions the null hypothesis is rejected. The highly jointly significant coefficients do not conflict with the relatively low fit measure, however (Greene and Hensher, 2010, p. 162). *Log likelihood* is the value of the log likelihood at convergence.

The results in Table 1.5 suggest two things about the PBC’s policy reaction. Firstly, the real output growth rate plays an important role in PBC’s objective function. The highly significant role of *GDP* in the model is consistent with a conventional understanding about the PBC’s monetary policy making. According to China’s Central Bank Law in 1995, the promotion of economic growth is the main ultimate policy goal. But the output gap between actual output and some long-term potential level is not that important. In contrast, output gap is regarded as an important variable in Taylor-type reaction functions. This finding is also consistent with the behaviour of the PBC, as neither ‘potential output’ nor ‘output gap’ have ever appeared in the statements or publications of the PBC.

Secondly, the PBC does not react significantly to the level of inflation in regression 4.1, but it reacts to the deviation of the actual inflation from the long-term level in regression 4.2. This raises an important issue: how does the PBC form its concerns over inflation? Probably the PBC is more concerned by the potential infla-

⁷See Greene and Hensher (2010, pp. 44–45).

Model	4.1	4.2
GDP	0.1521*** (0.0553)	0.0676 (0.0703)
CPI	0.0231 (0.0171)	0.1075*** (0.0283)
M	-0.0223 (0.0179)	0.0298 (0.0214)
NEER	-0.0007 (0.0123)	-0.0209 (0.0149)
ACCPCI	0.0067 (0.0308)	0.0323 (0.0306)
γ_1	0.3004 (0.4506)	-0.9704*** (0.1641)
γ_2	1.6783*** (0.4721)	-0.9704*** (0.1522)
<i>pseudo R</i> ²	0.0644	0.1293
LR statistic	13.0051	26.0856
Prob (LR statistic)	0.0233	0.0001
Log likelihood	-94.4042	-87.8739

Notes:

1. The estimation is carried out by Stata 11. In both regressions, the dependent variable is the policy change index, 1986Q1:2010Q3.
2. In regression 4.1, the independent variables are percentage growth rates except for ACCPCI; in regression 4.2 those independent variables are the deviations from their long-term trends using the HP filter approach.
3. The values in brackets are standard errors; ***, ** and * indicate significance at 1%, 5%, and 10%, respectively. Attempts have also been made to correct for heteroskedasticity, but it does not lead to any significant changes to the reported standard errors.

Table 1.5: Estimation results: percentage data (4.1), HP filter data (4.2)

tion pressures in the future, and such inflation expectations are likely to be driven by current output growth. This issue will be discussed in the next section using a narrative approach to find out the role of inflation for the PBC. In Figure 1.5, the real GDP growth rate exhibits a clear lead in comparison to CPI inflation, with an approximate three to five quarters lead over CPI inflation. It thus seems reasonable that the PBC reacts less strongly to CPI inflation, and more strongly to output growth.

Thirdly, the insignificant parameter on $M1$ seems a little surprising, as this monetary aggregate is widely believed to be the intermediate target of the PBC's monetary policy implementation. In recent years, China's rapid build-up of foreign exchange reserves, mainly driven by the trade surplus and capital inflows, is a major determinant of the increases in the stock of money under China's current pegged exchange rate regime. So the money supply depends passively on the inflow of foreign currencies, and is hardly affected by the PBC (given that the exchange rate is pegged). Moreover, due to the preference of the authorities for rapid domestic economic development, monetary policy is under pressure to promote economic growth, and is therefore directed to meeting the demand for money, especially when the inflationary pressure is acceptable to the authorities. Given that broad money supply is partly determined by the state of the economy and partly determined by the central government and the State Council, it makes some sense that the PBC's policy action is less responsive to the growth rate of monetary aggregate.

Fourthly, the insignificant role of $NEER$ is a bit unexpected, too. It suggests that changes in the nominal effective exchange rate do not lead to any significant change in the monetary policy stance. The inference looks inconsistent with the PBC's ultimate policy target which requires stability of the domestic currency. However, Liew and Wu (2007, p. 140) argue that in China it is fiscal policy rather than monetary policy that responds to the changes in the exchange rate. The authorities prefer to stimulate exports through fiscal subsidies rather than devaluing the currency. Liew and Wu also indicate that foreign direct investment (FDI) and fiscal subsidies are more important factors than the exchange rate in explaining China's exports which are one of the main driving forces of China's economic growth.

Finally, while our policy change index only describes changes in the monetary policy stance, the accumulated policy change $ACCPCI$ which provides an overall measure of the monetary policy level has an insignificant parameter. It suggests that the PBC's policy decision making does not have a clear quasi mean-reverting pattern in a short period. If it does, the movement of $ACCPCI$ would have been fluctuating around zero. But in fact, Figure 1.4 shows that $ACCPCI$ tends to fluctuate but takes years to exhibit one cycle. Specifically, the 'recessions' of $ACCPCI$ (policy expansions) are long-lived during 1990–94 and 1996–2005; while the 'boom'

in *ACCPCI* (policy contraction) lasts for years from 2006 to the end of the period.

Of course, the interpretation of the marginal effects in an ordered probit model is quite different from that in a classic OLS model. The sign and magnitude of the single parameters in Table 1.5 cannot be used directly in interpreting the partial effects of the probability, because this partial effect depends not only on the parameter of this variable, but also on all the other parameters of the independent variables.⁸ Hence, the partial effect on the change in the probability is ambiguous, since it could be either positive or negative. In order to facilitate further interpretation, we report the marginal probabilities holding all the other explanatory variables at their average level at the same time. For example, we consider the specific probability of monetary policy changes as a function of *GDP*, given the sample average values of *CPI*, *M1*, *NEER*, and *ACCPCI*, respectively. The partial effects from regression 4.1 are reported in Table 1.6, and the computation is carried out by *Stata 11*.

The first row of Table 1.6 gives the partial effects on the specific probabilities per percentage change in real GDP, while holding all the variables at their means. For a one per cent increase in real GDP, the probability of an expansionary change in monetary policy will decrease by 4.25 per cent; in contrast, the probability of a contractionary policy change will increase by 5.26 per cent. The effects on both expansionary and contractionary policy changes are significant at the 1% level. These changes in the probabilities are consistent with intuition. For the rest of the independent variables, an increase in CPI inflation and currency depreciation in terms of a decreasing NEER have negative partial effects on the probability of an expansionary policy change, and have a positive partial effects on the probability of a contractionary policy change. But these partial effects are small in size compared to that of real output growth, and not significant. The partial effects of monetary growth and accumulated policy changes are neither expected nor significant; in addition, the magnitudes of the partial effects on specific probabilities of policy changes are very small.

In Table 1.7, the results are quite similar given the inherent characteristics of regression 4.2 compared to regression 4.1. The partial effects of the deviation of CPI inflation from some target value are expected, considerable and significant holding all the variables at their means. When inflation exceeds its trend value by one percentage point, the probability of an expansionary change in monetary policy will decrease by 2.79 per cent; meanwhile, the probability of a contractionary policy change will increase by 3.65 per cent. The partial effect on an unchanged policy stance is -0.0087 which is not significant.

⁸For more details, see Greene and Hensher (2010, pp. 30–38).

Variables	Prob($PCI_t = -1$)	Prob($PCI_t = 0$)	Prob($PCI_t = 1$)
<i>GDP</i>	-0.0425*** (0.0159)	-0.0101 (0.0084)	0.0526*** (0.0192)
<i>CPI</i>	-0.0065 (0.0048)	-0.0015 (0.0016)	0.008 (0.0059)
<i>M1</i>	0.0062 (0.005)	0.0015 (0.0016)	-0.0077 (0.0062)
<i>NEER</i>	0.0002 (0.0034)	0.00005 (0.0008)	-0.0003 (0.0042)
<i>ACCPCI</i>	-0.0019 (0.0086)	-0.0004 (0.0021)	-0.0023 (0.0107)

*Note: The values in brackets are standard errors; ***, ** and * indicate significance at 1%, 5%, and 10%, respectively.*

Table 1.6: Partial effects for regression 4.1 at means of independent variables

Variables	Prob($PCI_t = -1$)	Prob($PCI_t = 0$)	Prob($PCI_t = 1$)
<i>GDP</i>	-0.0175*** (0.0184)	-0.0054 (0.0066)	0.023*** (0.0238)
<i>CPI</i>	-0.0279*** (0.0076)	-0.0087 (0.0063)	0.0365*** (0.0099)
<i>M1</i>	0.0078 (0.0056)	-0.0024 (0.0024)	0.0101 (0.0073)
<i>NEER</i>	0.0054 (0.0039)	0.0017 (0.0017)	-0.0071 (0.0051)
<i>ACCPCI</i>	-0.0084 (0.008)	-0.0026 (0.003)	-0.011 (0.0105)

*Note: The values in brackets are standard errors; ***, ** and * indicate significance at 1%, 5%, and 10%, respectively.*

Table 1.7: Partial effects for regression 4.2 at means of independent variables

1.5 A Forward-looking Model: The PBC's Words and Deeds

In Section 1.4, the results show that the PBC concerns output growth and inflation deviation from its long-term trend. But the reactions of the policy change index may not be strong due to a lower overall diagnostic of the model. In fact, what equation (1.2) assumes is a backward-looking reaction function of the PBC's monetary policy, so in this section we go for a forward-looking model to see if the PBC still concerns

output and inflation. Gerlach (2004) argues that the policy reactions of a central bank may depend critically on its interpretation of the macroeconomic data, rather than on observed macroeconomic data alone. In order to have a better understanding of the PBC's monetary policy responses, we extend our analysis by 'thinking like the PBC thinks'. In particular, we are interested to see whether the PBC's qualitative description of real economic activity, inflation and money growth can be used to interpret the PBC's monetary policy decisions. One plausible way to do this is to incorporate the information of these subjective interpretations into the ordered probit model.

In order to obtain the relevant information, we need something from the PBC which is similar to the Bank of England's Inflation Report. In 2001, the Monetary Policy Executive Report was first published as the official publication of the monetary authority. It publishes on a quarterly base and contains the following contents: an overview of monetary policy implementation in the previous periods; detailed economic analysis of output, prices and money supply; an overview of some important sectors such as agriculture, banking, the stock market, and the real estate market. In addition, the Executive Report presents an assessment of the prospects for China's macroeconomic development. We believe that the information revealed in the report, which has not yet attracted adequate attentions in relevant studies, provides us with a feasible way to explore what exactly the PBC bases its policy decisions on.

In the following analysis, we employ a narrative approach to develop a series of subjective indicators from the quarterly Executive Report released by the PBC from 2001Q1 to 2010Q3. From various issues of the Executive Report we find relevant statements of the PBC's views which reflect its own outlook for output, money growth and inflation. We believe that these statements best reflect the PBC's views about macroeconomic conditions. In order to code the assessments, we follow Gerlach (2004) in valuing the indicator variables such that:

- (1) The value 0 means that the PBC believes the current level of the variable is acceptable.
- (2) The value -1 indicates the behaviour of the variable may warrant a relaxation of the policy, because the current level of the variable is lower than acceptable.
- (3) The value 1 indicates the behaviour of the variable may warrant a tightening of the policy, because the current level of the variable is higher than acceptable.

The indicator variables are obtained by applying these rules to relevant statements gathered from the Executive Report, and then plotted in comparison to the corresponding macroeconomic data in Figure 1.6. More details on how the indicator

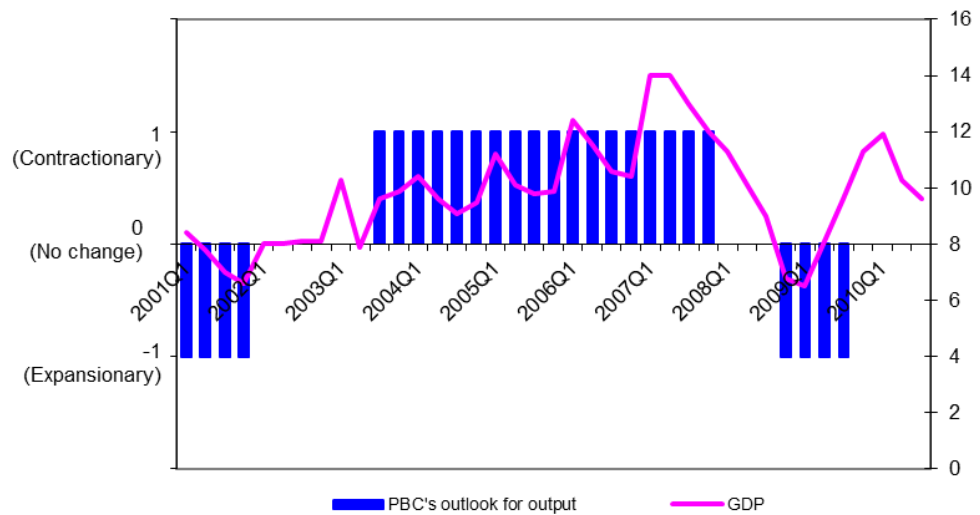
variables are obtained from the Executive Report are reported in Appendix A.2, A.3 and A.4. To our knowledge, this is the first time that such a method has been used for China's monetary policy studies.

From Figure 1.6 it can be seen that the judgments by the authorities roughly match the corresponding observed macroeconomic data. In the upper panel of Figure 1.6, the PBC was worried about the risks of overheating of the national economy during 2003–08. But before and after that time, the authorities tried to stimulate the economy by various means. From 2008Q3 to 2009Q3, as a result of the global financial crisis, the PBC considered output growth to be under its target. It can also be seen from the right panel of Figure 1.6 that the PBC's assessment of money growth matches well the actual M1 growth for most of the sample period.

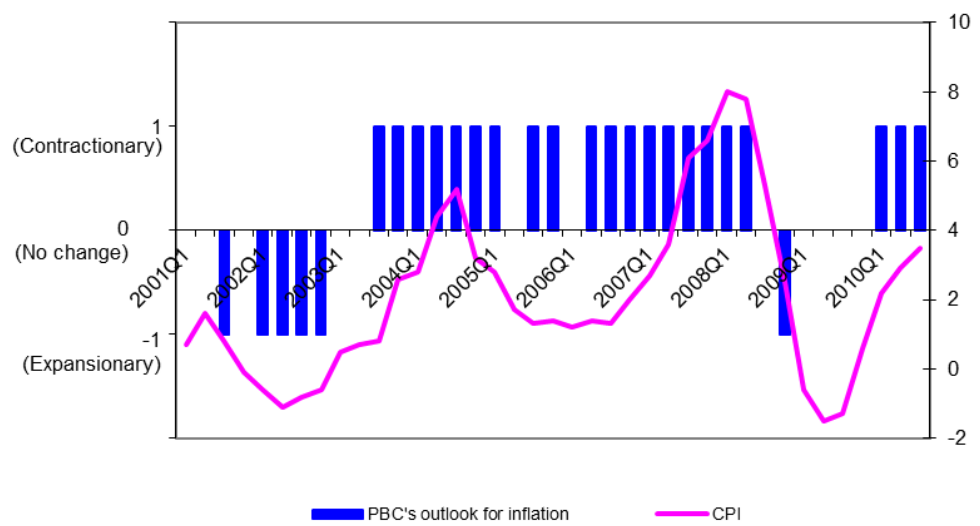
Meanwhile, some interesting findings can be seen across the graph with respect to inflation. The Executive Report suggests that in 2003Q3, the PBC regarded output growth as beginning to create overheating, and changed its judgment of the outlook for real economic activity from 0 to 1, although the previous actual CPI inflation was lower than one per cent. From 2003 to 2007, the PBC remained worried about the inflation risk, while the actual CPI inflation was declining. Similarly, in 2008Q1, the PBC switched its judgement on real economic activity from 1 to 0, and soon it became less worried about the inflation pressure, with the outlook for inflation falling to 0. The divergence between the PBC's outlook for inflation and actual inflation data is consistent with our analysis in the earlier empirical results, that is, output growth is an important determinant of the authorities' outlook for inflation. In addition, only a weak connection between the inflation indicator and the money indicator is observed. This may imply that the PBC does not regard current money growth as an important driving force of inflation, probably due to the PBC's powerful liquidity-absorbing operations in the money market through various monetary policy instruments.

Once the indicator variables are constructed, we run the regression in the ordered probit model again for the sample period of 2001Q1–2010Q3. The model now includes the following regressors: output indicator, inflation indicator, monetary condition indicator. As the accumulated policy change is insignificant in regression 4.1 and 4.2, it is dropped from the model. Meanwhile, to see if the PBC has a forward-looking monetary reaction function, we simply assume a perfect foresight of the PBC who makes correct and precise predictions about future value of output, inflation and money growth. The ex post data with a lead of four quarters is assumed to be PBC's prediction. As a representative regression we only use the growth rate data rather than HP-filter data (data that used in regression 4.1 but with a four-quarter lead). The estimation results are reported below:

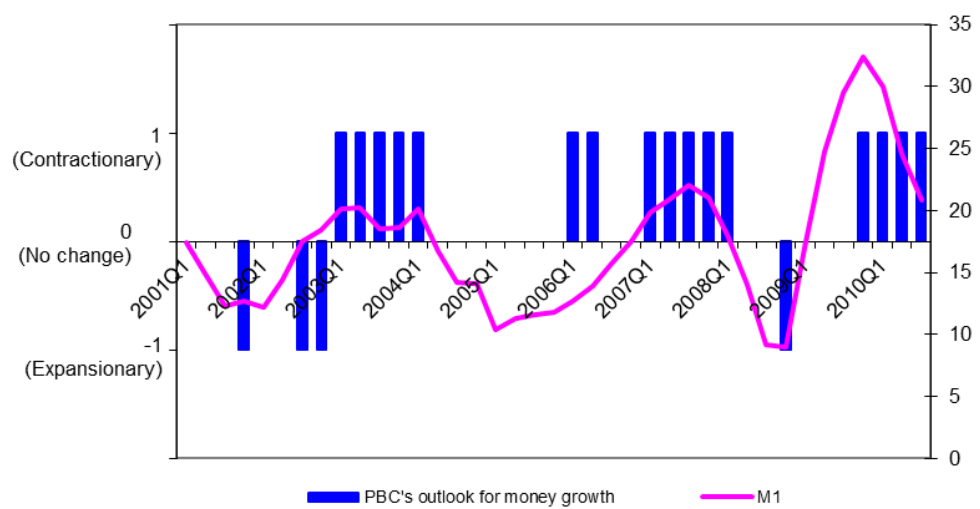
The first column in Table 1.8 shows that neither the output indicator nor the



(a) Output



(b) Inflation



(c) Money growth

Figure 1.6: PBC's outlook and actual macroeconomic data: 2001Q1–2010Q3

Model	5.1	5.2
Output	0.2104 (0.3237)	0.043 (0.1506)
Inflation	1.0671*** (0.3968)	0.2282 ** (0.1056)
Money growth	0.2742 (0.3741)	-0.1354*** (0.0489)
γ_1	-0.8078 (0.2884)	-2.8038 (1.3073)
γ_2	0.5766 (0.2842)	-1.4228 (1.3085)
<i>pseudo R²</i>	0.2839	0.249
LR statistic	22.45	9.8
Prob (LR statistic)	0.0001	0.0203
Log likelihood	-28.3012	-27.3447

Notes:

1. In both regressions, the dependent variable is the policy change index, 2001Q1:2010Q3.
2. In regression 5.1, the independent variables are the current values of the indicator variables derived from the PBC's Executive Report; in regression 5.2 those independent variables are actual percentage growth rates, with a four-quarter lead.
3. The values in brackets are standard errors; ***, ** and * indicate significance at 1%, 5%, and 10%, respectively.

Table 1.8: Estimation results: PBC's outlook (5.1) and expected data (5.2)

money growth indicator is significant. But the parameter on the PBC's outlook for inflation is highly significant at the 1% level. The insignificant parameters may not be surprising. Firstly, as Gerlach (2004) implies, the indicator variables we have obtained are relatively crude (they can take three different values only), so they may have some difficulties in explaining the monetary policy index. Secondly, as the Quarterly Report is only available since 2001Q1, the model has only 39 observations up to 2010Q3, which may substantially limit the performance of the ordered probit approach. Despite those limitations, regression 5.1 still indicates an important and significant role of inflation. In addition, the R^2 is much higher than those in Table 1.5, while the Prob (LR statistic) has no significant changes. The results in Table 1.9 suggest an expected partial effect of PBC's outlook for inflation on policy changes, with the largest magnitude of all. If the PBC considers that the inflation is above some acceptable level, holding all the other variables at their means, the probability of a loosening of monetary policy will decrease by 17.0 per cent, and the probability of a tightening of monetary policy will increase by 42.6 per cent, which is considerable.

For comparison purposes, when we assume that the PBC has perfect foresight

and use the ex post four-quarter data as the expected future value, we get similar results as in the second column of Table 1.8. In addition, the expected money growth is significant in explaining policy changes but the sign is not what is expected, as in Table 1.9, for a one per cent increase in monetary growth, holding all the other variables at their means, the probability of a tightening of monetary policy will decrease by 5.4 per cent. This perverse sign on monetary growth requires further investigations. In general, the estimation from regression 5.2 is consistent with that of regression 5.1: the PBC concerns inflation most, and responds to inflation expectations rather than expected output growth.

5.1	Prob($PCI_t = -1$)	Prob($PCI_t = 0$)	Prob($PCI_t = 1$)
Output	-0.0334 (0.0515)	-0.0505 (0.0808)	0.0839 (0.1291)
Inflation	-0.1696** (0.0848)	-0.2559* (0.1313)	0.4255*** (0.158)
Money growth	-0.0436 (0.0613)	-0.0658 (0.0926)	0.1094 (0.1492)
5.2	Prob($PCI_t = -1$)	Prob($PCI_t = 0$)	Prob($PCI_t = 1$)
Output	-0.007 (0.0243)	-0.0102 (0.036)	0.0171 (0.06)
Inflation	-0.037* (0.0195)	-0.0539* (0.0301)	0.091** (0.0418)
Money growth	0.022** (0.0093)	0.032** (0.0155)	-0.054*** (0.0193)

*Notes: The values in brackets are standard errors; ***, ** and * indicate significance at 1%, 5%, and 10%, respectively.*

Table 1.9: Partial effects at means of independent variables

More importantly, results from regression 5.1 and 5.2 indicate that prospective inflation, based on either the PBC's own assessment of the outlook or the actual data for four quarters ahead, plays a vital role in explaining its monetary policy changes. Thus, taking into account the leading implication of real GDP growth on inflation which we have discussed in Section 1.4, the PBC looks as if it is implementing some kind of 'implicit' inflation targeting regime. Our conclusion is consistent with some recent studies. He and Pauwels (2008) use a similar policy change index in an ordered probit model, and they point out that the PBC's policy stance can reasonably be explained by its stated policy objective of CPI inflation. Filardo and Genberg (2010) believe that the PBC has roughly shown a success in achieving a low inflation. They look at the time series characteristics of China's CPI inflation and examine them compared with other Asian countries. They argue that although China does not have an explicit inflation-targeting regime, the PBC has been able

to achieve strong inflation performance. These findings together with what we have found in this paper imply that the PBC could reasonable be characterized as an informal inflation targeter.

1.6 Conslusions

China's central bank, the People's Bank of China, has employed a range of different instruments in the implementation of its monetary policy over the past decades. This complicates the identification of the PBC's monetary policy stance because no single instrument would constitute an adequate representation of the monetary policy stance. We therefore follow He and Pauwels (2008) in constructing a new measure of monetary policy changes for the PBC. One remarkable feature of our measure (which we call a policy change index) is that it considers the changes in the various monetary policy instruments implemented by the PBC since 1986, and can therefore be considered as a comprehensive representation of the PBC's policy changes.

In order to capture how the PBC reacts to economic developments, we examine the policy change index in the framework of an ordered probit model. Some main conclusions are as follows. Firstly, current output plays an important role in the PBC's monetary policy decisions. Second, the PBC responds less strongly to current inflation conditions, but more strongly to the deviation of actual inflation from its long-term trend level. This may be because output growth has some leading implications for future inflation. Third, monetary policy changes are less closely tied to the growth rate of M1 and the nominal effective exchange rate. The reason for this may be that when the RMB appreciates, the authorities prefer to stimulate exports through fiscal policy in terms of subsidies rather than changing the monetary policy stance. Fourthly, empirical and graphical evidence suggest that the PBC's policy decision making has no clear characteristic of a quasi-mean-reverting pattern. However, the model using contemporaneous data available on output, inflation, monetary growth, and nominal effective exchange rate has a low goodness of fit, which suggests a relatively weak response of our policy change index to those data.

Therefore, we turn to a forward-looking monetary reaction function instead of the backward-looking one. Since the PBC's monetary policy decisions may depend on its own interpretations of the changes in the macro economy, we develop a set of subjective measures of these interpretations, the first time this approach has been done in studies of China's monetary policy. Firstly, we collect the PBC's outlooks and assessments of the macroeconomic conditions by reading the Quarterly Monetary Policy Executive Report between 2001Q1 and 2010Q3. Secondly, a set of

subjective indicator variables are constructed based on these statements. And next we test the policy change index with these indicator variables in the ordered probit model. Results show that when the PBC perceives a risk of a higher inflationary pressure, it will react by implementing a tighter monetary policy. Although there are fewer observations, we obtain a higher goodness of fit than in the backward-looking reaction model in Section 1.4. Finally, when we make a strong assumption that the PBC has a perfect foresight, we use a leading actual data in the regression. We find that inflation again turns out to be the most important variable. This forward-looking reaction function helps us to understand the important role of inflation in the PBC's monetary policy implementation. So it may be inferred that China is informally targeting inflation, although no explicit target has ever been announced by the PBC.

In summary, this chapter presents some preliminary but interesting analysis of China's monetary policy stance, and its reactions to the changes in economic conditions. The constructed policy change index may shed some light on the PBC's monetary policy decisions since 1986. It leaves room for further analysis which could, for example, develop a finer coding method to classify the PBC's policy stance (particularly when a long run of data are available), and investigate whether there is any difference between changes tightening policy and loosening policy, i.e. whether there is an asymmetric response by the PBC to changes in the state of the economy.

CONSTRUCTING THE MONETARY CONDITIONS INDEX FOR CHINA

2.1 Introduction

Monetary stability, along with financial stability, is the core function of central banks (Mayes and Wood, 2010). Monetary conditions, which are closely relevant to monetary stability, play a critical role in influencing the state of the economy. Given a number of different monetary policy instruments used by the People's Bank of China, it is reasonable to infer that China's monetary policy affects aggregate demand through more than one transmission channel. In order to get a better understanding of how monetary actions influence monetary conditions and from there go on to affect aggregate demand and inflation, a comprehensive measure of monetary conditions in the context of China appears to be of great importance.

Traditionally, an interest rate channel and an exchange rate channel are widely used to describe the impact of monetary conditions in determining aggregate demand and inflation. A rise in the interest rate would drive up the cost of investment and reduce aggregate demand; an appreciation of the domestic currency would also reduce aggregate demand by making export products less competitive (and imports more competitive) and would, therefore, affect economic activity. It is thus common to use a monetary conditions index (MCI) which is a weighted average of an interest rate and an exchange rate relative to their values in a based period. Ericsson et al. (1997) indicate that the MCI has several attractive features: it is easy to understand and to calculate, and it captures both the domestic and foreign influences on the general monetary conditions of a country. Moreover, it is a useful information tool for institutions and the public, and as a leading indicator for the monetary authority in their policy considerations.

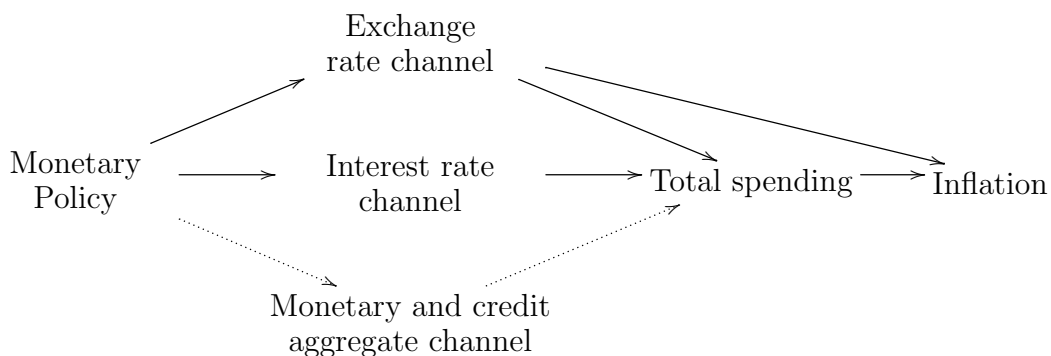
The aim of chapter 2 is to calculate such an MCI for the Chinese economy, which can be used to assess the effects of changes in short-term monetary variables on developments in the main economic variables. To derive an appropriate MCI for China, it is desirable to account for essential features of China's monetary conditions. For example, the bank credit channel was the dominant channel in the 1980s and 1990s, which still plays a prominent role in affecting monetary conditions. Therefore, focusing on the credit channel besides the conventional channels is particularly relevant in the study of China's monetary conditions.

The chapter is organized as follows. Section 2.2 provides an overview of analytical and practical issues for the MCI. Section 2.3 discusses the choice of variables and data in constructing the MCI for China. In particular, two different approaches are adopted to derive relative MCI weights. Section 2.4 provides visual checks of the MCIs with output, inflation, and monetary policy actions during 1987–2010. Section 2.6 examines the leading implications of the MCIs by using different econometric tests. Section 6 gives the conclusions and suggests direction for future research.

2.2 Literature review

In a paper widely quoted by the subsequent studies on the MCIs, Duguay (1994) discusses the fundamental economic motivation and usefulness of the MCIs. He argues that central bank monetary actions have a more direct link to short-term interest rates and to the exchange rate than to monetary aggregates in the context of Canada in the 1990s. The central bank can induce the financial institutions to bid more or less aggressively for overnight loans through the monetary policy instrument, and thus exert a fairly direct impact on the overnight rate. The real exchange rate would also move in response to such policy actions, in an open economy with a high degree of substitutability between domestic and foreign currency assets. In addition, the price effect of exchange rate movements may speed up the adjustment of domestic prices. Hence, monetary policy operates through changes in short-term interest rates and exchange rates to influence total spending and prices. The general transmission process of monetary policy can be characterized in Figure 2.1, where dashed lines indicate a weaker channel suggested by Duguay. He also suggests that the interest rate and exchange rate channels exhibit strong linkages to total spending, and from total spending and exchange rate to inflation in the context of Canada. Thus, both the short-term interest rate and the exchange rate channels play key roles in equilibrating aggregate demand and aggregate supply.

On the basis of the discussion by Duguay, Freedman (1994, 1995) firstly participated in experimenting the way at the Bank of Canada in which interest rate and exchange rate were fitted together to guide monetary policy. Specifically, he focuses



Source: Duguay (1994).

Figure 2.1: Transmission channels of the monetary policy

on the combination of a short-term interest rate (the 90-day commercial paper rate) and a trade-weighted exchange rate. The MCI is defined as follows

$$MCI_t = \theta_r \cdot (r_t - r_0) + \theta_e \cdot (e_t - e_0) \quad (2.1)$$

where r_t and e_t are the real interest rate and real exchange rate, respectively; t is the time index, where $t = 0$ indicates the base period; θ_r and θ_e are the respective weights on the interest rate and exchange rate. Duguay (1994) estimates a single aggregate demand equation, and his estimated ratio of the weights of interest rate and exchange rate is 3:1. It suggests that a 1 percentage point change in the real interest rate has about the same effects over time on aggregate demand, as a 3 per cent change in the real effective exchange rate.¹ Freedman also provides reasons for focusing on the relative effects on aggregate demand rather than on prices. He argues that in Canada, it is the output gap and expected inflation that are the main driving force behind the changes in inflationary pressures; in addition, it is the changes in aggregate demand that are a key determinant of changes in the output gap. Mayes and Virén (2000) also emphasize the importance of aggregate demand by arguing that there is a range of supply-side influences on inflation that are best captured in a separate manner.

To illustrate the usefulness of the MCI, Freedman (1995) refers to two aspects. First, there may be uncertainty about the exchange rate response to the policy rate changes: on the one hand, the policy rate increase may result in a small increase in the short-term interest rate and a significant appreciation of the domestic currency; on the other hand, the same change in the policy rate may cause a substantial increase in short-term rates and a small appreciation of the currency. The outcome depends on how long the market expects the interest rate to rise, and how sensitive

¹Freedman notes that different models have been used to obtain the relative weights, including structural models, vector autoregression (VAR) models and reduced models, and these models give quite different answers on the separate effects of interest rate changes and exchange rate changes on aggregate demand. However, the results are similar for the relative sizes of the effects. See Freedman (1994).

are the movements in the expected exchange rate to the actual movements in the exchange rate. Then, if the authorities focus only on the interest rate channel, they might ignore the downward pressure on aggregate demand through the currency appreciation. Thus, focusing on an MCI which emphasizes the role of the exchange rate channel along with the interest rate channel can avoid the potential error of bringing too much or too little stimulus to the economy. Second, Freedman indicates that when there is an exogenous shock to the exchange rate, the MCI can promptly capture such a change in the monetary conditions, and clearly points out the need to take action to offset the effect of such movements on aggregate demand. For example, if there is a loss of confidence in the domestic currency, a further depreciation may take place due to the shift out of the asset denominated in the domestic currency. This will lead to over-expansionary monetary conditions, and the central bank will need to take tightening actions. In the absence of the MCI, there is a greater likelihood that the central bank would not take timely action to offset the expansionary effect of the depreciation. In that case, monetary conditions may be inappropriately eased until a complete assessment of the exchange rate change is carried out. On the contrary, if the central bank keeps an eye on the MCI, the need for tightening action would show up directly since the index would show the easing due to the currency depreciation. Freedman implies that the MCI helps to include the effects of the changes in the exchange rate on aggregate demand when short-term interest rates are adjusted.

In spite of the advantages advocated by Freedman and others, the use of MCIs as an operational target in conducting monetary policy has suffered severe criticisms. For example, targeting the exchange rate in terms of the MCI may cause the wrong policy response when the shock of the exchange rate is not properly identified. Mishkin (2001) argues that whether interest rates and exchange rate have offsetting effects on output and inflation depends on the nature of the exchange rate shocks. Exchange rate falls usually result in higher inflation in the future, so interest rates need to increase to offset the upward pressure on inflation. However, if the exchange rate depreciation comes from a real shock such as negative terms of trade shock, aggregate demand would fall and the effect is unlikely to be inflationary. In such a circumstance, the appropriate policy response should be an interest rate cut, not a rise as the MCI suggested. Given the criticism of using the MCI as an operational target of the monetary policy in practice (Eika et al., 1996; Mishkin, 2001; Smets, 1997), the Reserve Bank of New Zealand decided to give up the MCI as operational target in 2000.² The Bank of Canada also decided to discontinue the MCI from 31 December 2006, and the Bank announced that the MCI would not be used as an input into its monetary policy decisions.³ It is believed that currently none of the

²See Gan and Kwek (2008).

³See the website of the Bank of Canada, <http://www.bankofcanada.ca/en/rates/indicators/mci/>.

central banks around the world is still using the MCI as its operational target.

However, Batini and Turnbull (2002) propose another use of the MCI as an indicator of monetary policy stance. They argue that unlike being the operational target of monetary policy, the MCI as a measure of monetary policy stance does not require a change in the status of monetary conditions. If it is used only as an indicator, it is not used to inform any changes in monetary conditions directly, but rather to provide information about the level of the policy stance. For example, it can indicate whether the policy has become ‘tight’ or ‘loose’ relative to other periods. In this situation, the MCI is a ‘leading’ indicator of the policy stance, as changes in current interest rates and the exchange rate would have some effects on future output and inflation. In practice, the central banks of Norway and Sweden have used the MCI as an indicator of monetary conditions when formulating their monetary policies.⁴ However, it is argued that given the endogenous responses of the MCI to economic developments, the MCI may not be suitable as a feasible measure of the stance of monetary policy, for example, when the changes in the MCI mainly reflects shocks to the aggregate demand.

In addition, Mayes and Virén (2000) propose an alternative use of the MCI: an instrument for communicating changes in monetary policy by central banks. Central banks have found MCIs useful in communication because they make clear the relative importance of the exchange rate in the transmission of monetary policy. The MCIs appear to be particularly useful when the central bank is 1) projecting paths of monetary conditions over the future; 2) explaining the setting of central bank interest rates; and 3) explaining what short-run fluctuations in the exchange rate and market-determined interest rates might threaten price stability. Since some non-central bank sectors may also use the MCI, “simply speaking in that language might help central banks in their explanations”.⁵ The authors also outline other uses of the MCI by different groups other than central banks. Firstly, some international organisations use the MCI to assess the pressures on the economy and the macroeconomic policy stance across countries. For example, both the IMF and OECD have recently used the MCIs to assess the stance of monetary policy in their periodic publications, *World Economic Outlook* and *OECD Economic Outlook*, respectively. Mayes and Virén point out, however, that the IMF is more interested in short-term changes when it uses the MCI; on the contrary, the OECD looks into the evolutions over a longer time horizon which usually covers several years. Secondly, some private-sector financial institutions also use the MCI as an indicator, for example, Goldman Sachs and JP Morgan.

Meanwhile, a bulk of literature focuses on how to improve the MCI as an infor-

⁴See Ericsson et al. (1997).

⁵See Mayes and Virén (2000).

mative indicator of the monetary conditions. Batini and Turnbull (2002) propose a method to construct the MCI by taking into account the dynamic effects of interest rate and exchange rate on output. The MCI they derived is so called a ‘dynamic MCI’ (DMCI), which is calculated as follows:

$$DMCI_t = \theta_{r1} \cdot (r_{t-2} - r_0) + \cdots + \theta_{r12} \cdot (r_{t-2-k} - r_{0-k}) + \theta_{e13} \cdot (e_{t-6} - e_0) + \cdots + \theta_{e24} \cdot (e_{t-6-k} - e_{0-k}) \quad (2.2)$$

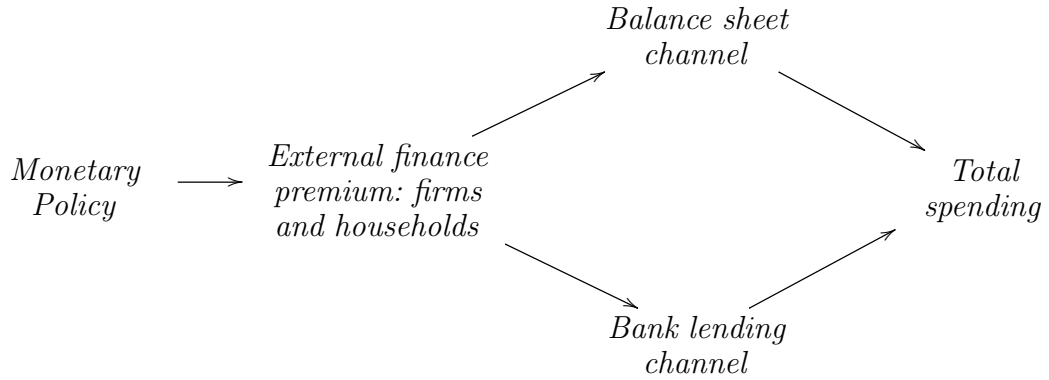
Notably, compared with the definition in equation (2.1), the first terms of interest rate and exchange rate are r_{t-2} and e_{t-6} , respectively. Batini and Turnbull explain that these are the lags at which the interest rate and exchange rate make their first appearance in the models’ estimated equations.⁶ This dynamic specification allows for the different impact over time of the interest rate and exchange rate on output. However, such a design of the MCI may not be appropriate in developing countries with relatively unstable monetary conditions such as China. Given the transitional nature of those developing countries, it is common to see large changes in monetary variables. By including lags of the component variables in the MCI, the effects of shocks to those variables on the MCI are likely to be long-lasting over time. The resulting exaggerated fluctuations in the series of DMCI may thus indicate unclear, even inaccurate signals of changes in the monetary conditions.

Besides introducing the dynamic structure into the MCI, there are other monetary policy transmission channels considered in the construction of the MCI. Bernanke and Gertler (1995) outline some economic intuition for considering the credit channel, and they examine the credit channel as an alternative to the standard monetary transmission mechanism.⁷ They argue that the effects of monetary policy on interest rates are amplified by endogenous changes in the external finance premium (the difference in cost between funds raised by issuing equity or debt and by retaining earnings). The central bank can affect this external finance premium in the credit market through two linkages: the balance sheet channel, and the bank lending channel. The fluctuations in the quality of the borrower’s balance sheets, caused by a tightening of policy, affect the external finance premium and in turn affect their investment and spending decisions. Such a process magnifies the effects of monetary policy through the interest rate channel. More importantly, monetary policy can also affect the external finance premium by shifting the supply of loans available from commercial banks, which provides a better fit of China’s practical situation. In countries where banks remain the primary source of credit, a reduction in bank

⁶Batini and Turnbull (2002) estimate a small-scale macroeconomic model over the period 1984Q4–1999Q3 for the UK. The model has six equations with six variables: output, inflation, nominal interbank rate, real effective exchange rate, real yield on ten-year government bond, and real short-term interest rate.

⁷However, Bernanke and Gertler (1995) argue that this credit channel is an enhancement mechanism, not a truly independent or parallel channel, in the context of the U.S.

credit supply is likely to increase the external finance premium and to reduce real activity. The monetary authorities can thus affect the supply of bank loans by open market sales which drain reserves and deposits from the banking system. The process can be described in Figure 2.2:



Source: Bernanke and Gertler (1995).

Figure 2.2: Credit channels of monetary policy

Because bank credit plays such a vital role in the transmission mechanism of monetary policy in China, it seems necessary to incorporate the credit factor into the construction of the MCI. Peng and Leung (2005) estimate the MCI for China by extending the MCI to incorporate the credit channel of monetary policy. Specifically, they include a variable for credit growth in their broad MCI. This innovation in constructing the MCI was then taken up by Kannan et al. (2006) in their work on India. They argue that credit supply is a vital channel of monetary policy transmission mechanism in the context of India, where the banks still play a dominant role in channelling loans to firms. Bu and Zhou (2004) also calculate the MCI for China by replacing bank credit with broad money supply M2. They argue that the PBC influences aggregate demand and inflation through broad money supply. Note that M2 consists of the currency in circulation and various time-related deposits. Compared to bank loans, the deposits play a less direct role in affecting aggregate demand and inflation. Moreover, using broad money supply as a component of the MCI requires a stable velocity of money which provides the link between M2 and the nominal outcome. However, no relevant discussion on this issue is carried out by Bu and Zhou. Therefore, their approach of using M2 is less than convincing and appears to be inferior to that of Peng and Leung in reflecting future economic conditions.

More recently, studies have been attempting to expand the MCI to measures of financial conditions, which is called a financial conditions index (FCI). Some studies imply that property and equity prices may play a prominent role in the transmission mechanism through a wealth effect channel as well as a credit channel. They argue that when asset price changes affect the financial wealth of households, their consumption decisions will be changed. In turn, aggregate demand would be influ-

enced through changes in spending by households. Goodhart and Hofmann (2001) incorporate house and share prices in their FCIs for 17 developed countries during 1973–98. They argue that the FCIs contain useful information about future inflationary pressures. Gauthier et al. (2004) come to a similar conclusion that the FCIs for Canada during 1981–2000 seem to do much better at capturing the turning points in the business cycle. However, they also point out that the role of the FCIs is still controversial, as the contribution to the determination of aggregate demand and inflation remains open.

Despite the advantages of the FCI for developed financial markets, a measure of monetary conditions incorporating asset prices may be inappropriate for China. The main reason is that given a less than liberalized financial market, the links between China’s asset prices and the aggregate demand through the potential wealth effect remains unclear. Other obstacles include issues of data availability and markets segmentation of the asset prices in the 1980s and 1990s. However, it does not preclude the use of asset prices as indicators of total spending in China in the future. The role of asset prices in the conduct of monetary policy for China is crucial and deserves attention, but relevant discussion on this issue is beyond the scope of this chapter.

2.3 The Derivation of the MCI for China

The MCI is conventionally defined as a weighted average of changes in interest rate and exchange relative to the values in some base period. Thus, the choice of weights and variables are two crucial factors in constructing the MCI. Conventional methods to weight the component variables include the reduced-form aggregate demand equation, vector autoregression regression (VAR) impulse response functions, and simulations of a complex macro-econometric model. These methods are described by Batini and Turnbull (2002), Mayes and Virén (2000), and Gauthier et al. (2004), and are presented in Table 2.1.

The reduced-form aggregate demand model may be the most widely used method in the construction of the MCI. It typically uses an IS-curve that relates output to interest rates, exchange rates and other relevant variables. The first estimates of the MCI used by the Bank of Canada in practice were based on estimation of this reduced-form model by Duguay (1994). The Reserve Bank of New Zealand and some other central banks also followed this method. Regardless the popularity of this method, however, there are several criticisms against it. Firstly, one fundamental assumption of this method is that all the independent variables are exogenous to each other and to the real economy. Such an assumption may lead to estimation bias and identification problems, for example, the problem of parameter constancy. Second, it usually takes some time for the variables to affect output, so the dynamic

Institutions /authors	Short-term interest rate	Long-term interest rate	Exchange rate	Other variables	Model
Bank of Canada	Nominal 90-day commercial paper rate	-	Nominal C-6 index	-	Reduced form of IS curve
IMF for U.K.	Nominal LIBOR	-	£ERI	-	-
J.P. Morgan for Canada (2002)	Nominal 3-month market rate	10-year corporate spread	Nominal C-6 index	Nominal TSX index; yield curve; M1; M2.	Simple average
Kennedy and Van Riet (1995) for U.K.	Nominal 3-month market rate	10-year government rate	£ERI	-	Structural macro model
Banque de France for G-7	Real 3-month market rate	Real 10-year government rate	REER	-	IMF's and OECD's macro models
Mayes and Virén (2000)	Real 3-month market rate	-	Real bilateral rate against U.S. dollar	Real stock price; house prices	Reduced form of IS curve
Goldman Sachs for Canada	Real 3-month market rate	-	REER	Measure of stock valuation; yield curve	Simple average
Goldman Sachs for U.S.	Real 3-month LIBOR rate	Real A-rated corporate, indexed	Real trade-weighted rate	Equity market cap/GDP ratio	Fed macro model
Goldman Sachs for U.K.	Real 3-month market rate	Real 10-year government rate	£ERI	-	Reduced form of IS curve
Goodhart and Hofmann (2001) for G-7	Real 3-month market rate	-	REER	Real stock price; real property prices	Reduced form of IS curve; VAR model.
Lack (2003)	Real 3-month LIBOR rate	-	Real trade-weighted rate	Real property prices	Shocks to restricted and structural macro model.
Deutsche Bank for U.K.	Real 3-month market rate	-	£ERI	-	Reduced form of IS curve

Notes: LIBOR denotes London Interbank Offered Rate; £ERI denotes Sterling real effective exchange rate index.

Sources: Batini and Turnbull (2002); Gauthier et al. (2004).

Table 2.1: Methods to derive the MCIs or FCIs

structure would be complicated in the estimated equation. The number of lags varies substantially across the models of different studies on the MCIs.

A second route for deriving weights for the component variables of the MCIs is to use VAR impulse response functions. The weights can be derived from the accumulated impulse responses. Compared with the reduced-form model, the VAR model exhibits some advantages. Firstly, no assumption that the variables in the MCI are exogenous to output or to each other is needed; therefore, all variables are treated as endogenous. Second, it allows for multiple relationships among the variables. Thirdly, it needs no specifications about the exact structure of the economy. Thus, it can be used to address the criticism of model dependency and non-exogeneity. Although the issue of identification restrictions to distinguish the relationships remains controversial, Mayes and Virén (2000) argue that this method still provides an informative description of the characteristics of the data.

Complex macro-econometric models are also used by central banks for forecasting and monetary policy analysis. In recent years, forward-looking expectations and monetary policy reaction functions have been incorporated into the macro-models. These models are intended to capture structural features of the economy and transmission mechanism, and may be better than the first two methods. However, there remains a lack of consensus in the literature on the channels through which some component variables of the MCI affect aggregate demand, such as asset prices. In addition, most of the models used by central banks are not published, so the non-central bank sectors would not be able to use those models. A further problem in using some complex models is that the estimated results vary according to the data period over which the model is run. Duguay (1994) warns that these models “*have been particularly unreliable in quantifying the effect of monetary policy, generally underestimating the effect of interest rates on spending and the strength of supply-demand imbalances on the inflation process*”.

In order to incorporate sufficient information about monetary pressure, we also take into account the credit channel and incorporate the credit variable in constructing the MCI. As the calculated MCI may be sensitive to different choices, two different methods are proposed to construct the MCIs: the reduced-form model, and the VAR model. The former intends to address the criticism about the dynamics of the weights over time, and the latter aims at dealing with the criticism of non-exogeneity and model dependency. Both the estimations are carried out using quarterly data starting from 1987:Q1 to 2010:Q2.

2.3.1 Choice of variables and data

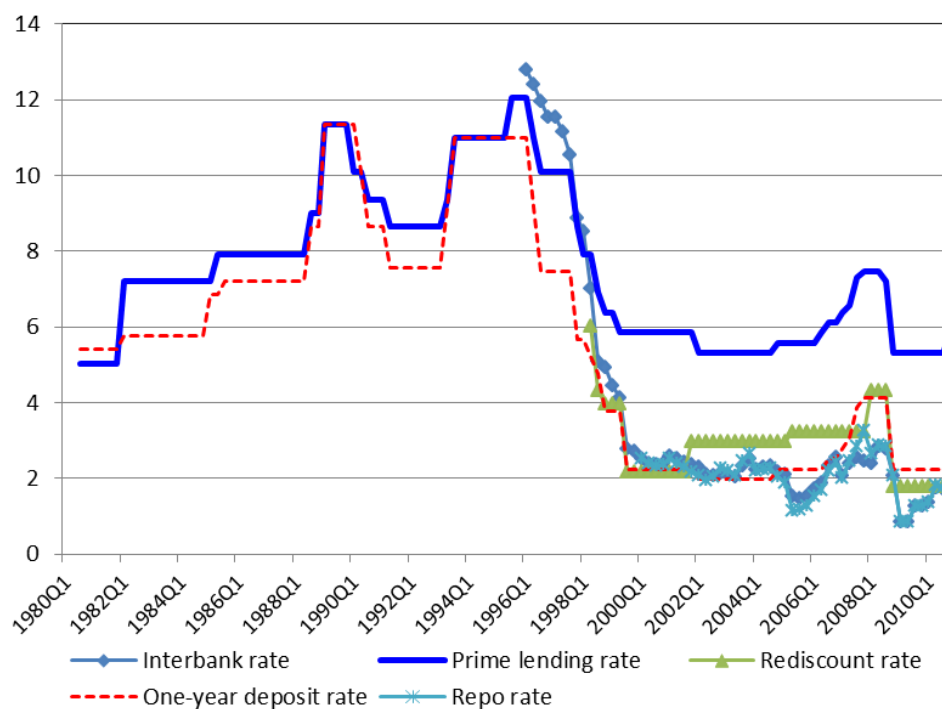
It is standard for almost all the MCIs to include a short-term interest rate and an exchange rate which contain useful information about monetary conditions. The choice of the interest rate may have a decisive impact on the MCI and should be made with caution. In the context of China, while a majority of interest rates are determined by the monetary authorities, they move in quite a similar pace with infrequent changes. Figure 2.3 shows that the prime lending rate, rediscount rate, and one-year saving deposit rate. It can be seen that those rates moved up or down in parallel and had fairly infrequent changes.

Given the parallel movements of different interest rates, we choose the prime lending rate as the component interest rate in the MCI which measures the borrowing cost for the short-term loans. As Figure 2.4 shows, the short-term loans accounted for over 50 per cent of total loans till 2003 and remained a significant element in total loans thereafter. Therefore, we treat the prime lending rate as a representative interest rate in China's banking and financial markets. Although short-term interbank rates in the money market are often used as an indicator of short-term interest rates, they may not be a feasible choice for the practice in China due to the segmentation of China's credit market. Besides, the size of the interbank market compared to the commercial bank loans is relatively small. For example, the total amount of interbank transactions in 2001 was 808.2 billion yuan, only 12 per cent of the short-term loans and 7 per cent of total loans in that year. Although there has been rapid development in the money market, the lack of a sufficiently long period of repo rates substantially limits its usefulness in most econometric estimations. Another possible choice of the interest rate is the repo rate. However, as the PBC first started repo transactions in 1999, choosing the repo rate as the representative interest rate is subject to the same constraint that the interbank rates suffer.

In the absence of survey data on inflation expectations, we use the four-quarter lead of CPI inflation to deflate the nominal rate, assuming a perfect foresight of the individuals. So the real interest rate could be expressed as follows, where CPI_{t+4} is the CPI inflation with a lead of four quarters.

$$r_t = i_t - CPI_{t+4} \quad (2.3)$$

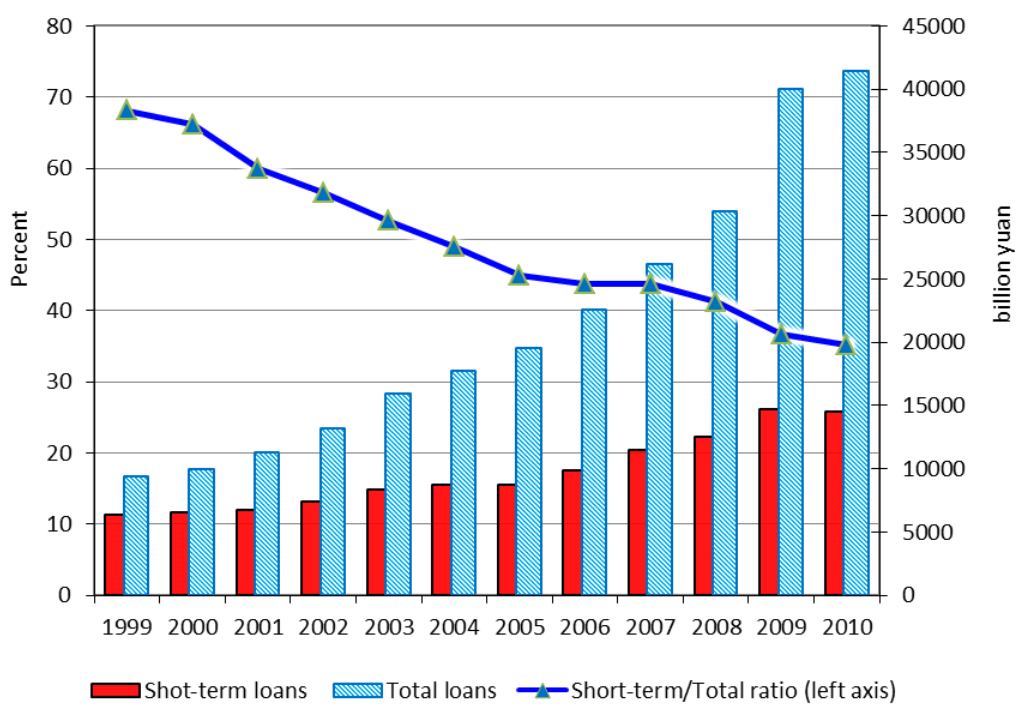
Under the pegged exchange rate regime in China, we look at the real effective exchange rate (REER) as the exchange rate component, which is a popular choice in constructing the MCI. The REER we use is calculated on the basis of CPI by the IMF in the IFS. According to the IMF, the REER is a comprehensive summary measure of the prices of one country's goods and services relative to the prices of goods and services in that country's trading partners. It is typically calculated as



Source: DataStream.

Note: the interbank rate and repo rate are calculated as quarterly average of the monthly rates.

Figure 2.3: Various nominal interest rates in China: 1996Q1–2010Q4



Source: the PBC.

Figure 2.4: Short-term loans versus total loans: 1999–2010

a weighted average of the ratios of a country's domestic price index to the price indices of its foreign trading partners. Note that there may also be an exchange rate pass-through effect from the nominal exchange rate to import prices and from there to domestic prices. However, by examining the nominal effective exchange rate pass-through effects on the CPI inflation in China, Ca'zozzi et al. (2007), and Wang and Li (2010) both indicate that such a pass-through effect to the CPI inflation in China is found to be very low. Therefore, we only focus on the effect of exchange rate changes on inflation through the aggregate demand channel.

As we have discussed earlier, the bank lending channel remains quite relevant in assessing the overall monetary conditions in China. According to the credit view, a simple bank lending channel could be expressed as follows:⁸

$$\text{Monetary Policy} \rightarrow \text{Bank deposits} \rightarrow \text{Bank loans} \rightarrow \text{Investment} \rightarrow Y \quad (2.4)$$

This process shows that when the PBC implements an expansionary monetary policy to increase the money supply, bank reserves increase and so do the bank deposits, which in turn increase the amount of bank loans available. This increase in loans will then be made available by the banks to firms and causes an increase in investment spending. Finally, such an expansionary policy will lead to an increase in aggregate demand and a rise in output. One example of the importance and powerfulness of the bank lending channel was in 2007 when the inflation became serious. The PBC then declared a switch of the monetary policy stance from a 'neutral' one to a 'tight' one via a cooling down of bank loans. The authority implemented ten rises in the reserve requirement ratio which amounted to a total increase of 5.5 per cent. The substantial increase in banks' deposits at the PBC then effectively reduced the loanable funds to the private sector. Since 2003, the reserve requirement ratio has become a key policy instrument for influencing aggregate demand via this credit channel.

For the indicator of bank credit, we look at the quarterly new credit to GDP ratio during 1986Q1–2010Q4, which gives the relative size of the credit supply to the nominal output. It is calculated as the nominal new credit divided by the nominal GDP. There are several potential advantages of using such a notion in constructing the MCI. Firstly, the credit ratio provides a smoother series than the year-on-year or quarter-on-quarter credit growth which may contain spurious volatilities. For example, if there is an unprecedented, temporary expansion in credit, the amount measured by the sequential growth would fluctuate sharply not only in the current year but also in the following year. One example is in 2009 when the new loans nearly doubled to RMB 9,600 billion compared with 2008 which can cause considerable swings in the series. Secondly, we use the amount of increment of credit instead of

⁸See Mishkin (2004, p. 621).

the outstanding credit because the former appears to be a more important indicator to the monetary authorities, as new credit quotas were mentioned by the PBC at the beginning of the year as guidelines for the subsequent monetary policy; on the contrary, the outstanding credit is hardly discussed and appears to be of less importance to the PBC. Thirdly, normalizing the new credit by the size of the economy can cut out the effects of business cycles on the bank credit. It can therefore provide a measure of ‘real’ bank credit growth immune to nominal cyclical patterns of the credit demand. In fact, the notion of scaling the credit by nominal GDP is used widely in studies of bank credit, for example, by the Bank for International Settlements (BIS).

Variable	Definition	Source
y	4-quarter percentage growth of real GDP	Abeyasinghe and Rajaguru (2004); DataStream.
r	Nominal prime lending rate deflated by CPI inflation with a 4-quarter lead.	Author’s calculation; IFS.
e	4-quarter percentage change of the real effective exchange rate	Author’s calculation; IFS.
$credit$	The ratio of new domestic credit from the banking system to nominal GDP.	Author’s calculation; DataStream; IFS.

Table 2.2: Definition and data sources of variables

In Table 2.2, we present the summary descriptions of the variables used in estimation, and the sources of data. We also plot all the variables in Figure 2.5.

According to the definition, the MCI we construct contains three components: the real prime lending rate, the REER, and the credit supply. By extending equation (2.1), the MCI can be expressed as:

$$MCI_t = \theta_r \cdot (r_t - r_0) + \theta_e \cdot (e_t - e_0) - \theta_{credit} \cdot (credit_t - credit_0) \quad (2.5)$$

where θ s are the relative importance of the component variables on the aggregate demand. Typically, an increase in credit supply is assumed to have an opposite impact on aggregate demand compared to an increase in interest rate and exchange rate (appreciation). Therefore, the sign in front of the weight on credit is negative.

2.3.2 IS-based model

The IS equation is one of the Keynesian baseline frameworks, through which monetary policy affects output via interest rates and exchange rate. We adopt the strategy similar to that of Duguay (1994), Dennis (1997), Mayes and Virén (2000), and Goodhart and Hofmann (2000). As can be seen in Table 2.1, such a method is widely used

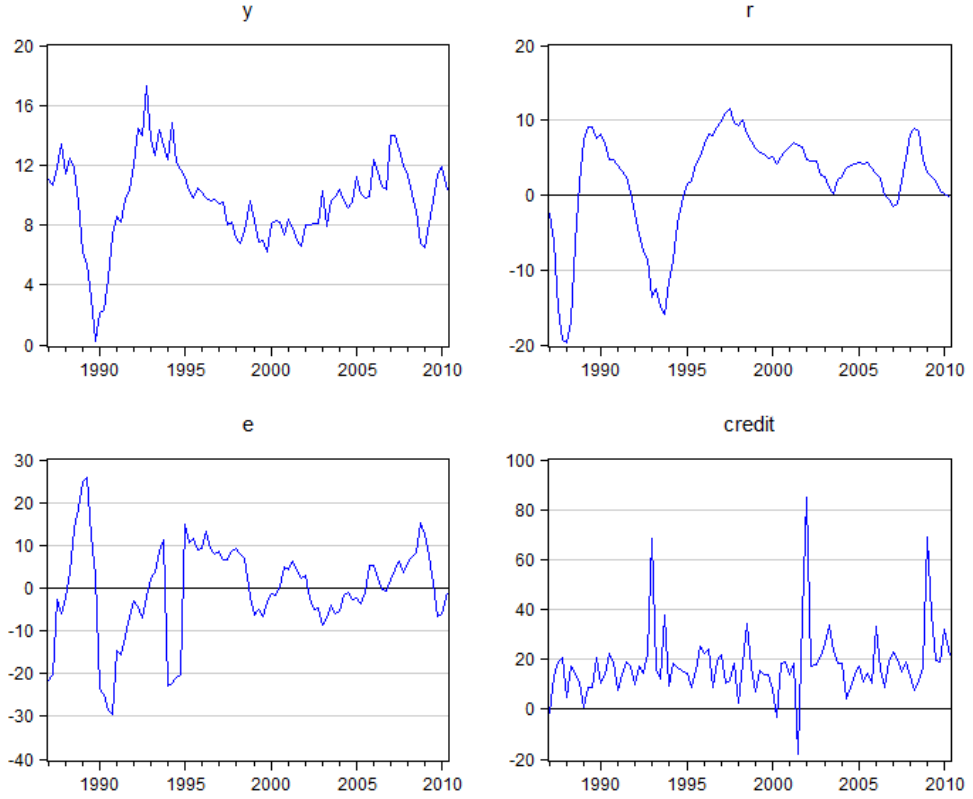


Figure 2.5: Four variables in analysis: 1987Q1–2010Q4

in the construction of the MCIs. For example, it was used by the Bank of Canada for Canada, Goldman Sachs for U.K, and Deutsche Bank for U.K. Conventionally, the IS curve can be specified in either a forward-looking way, or a backward-looking way, or a mix of the two. The difference between those two specifications is that the former assumes that the output depends on its expected future value, and the latter assumes that the output partly depends on its own past path. Goodhart and Hofmann (2005) indicate that a purely forward-looking specification is unable to match the lagged and persistent response of output to demand and supply shocks. The backward-looking specification, on the other hand, is typically preferred by the data, but have to be introduced in an ad hoc way.

We use a backward-looking specification of the IS curve, in which we assume the output depends on its own lag polynomials, the current and lagged real interest rates and real exchange rates. It is reasonable to assume the output of China has habit persistence in consumption and investment if one considers the large size of its economy and output. So in the IS-based model specification, output depends on its past values. As we have already discussed, the MCI we construct accounts for the credit channel of the monetary policy transmission mechanism. This approach follows Peng and Leung (2005) who extend the construction of the MCI for China taking into account the credit channel. A conventional IS curve can be expressed as follows:

$$y_t = \alpha_1 + \sum \alpha_{2k} y_{t-k} + \sum \alpha_{3l} r_{t-l} + \sum \alpha_{4m} e_{t-m} + \sum \alpha_{5n} credit_{t-n} + \sum \alpha_{6p} y_{t-p}^* + \nu_t \quad (2.6)$$

where domestic output y_t depends on its own lags, the real interest rate r , the real exchange rate e , the credit to GDP ratio $credit$, and the foreign demand y^* measured by the four-quarter percentage growth of the industrial production of the OECD countries. ν_t denotes the domestic demand disturbance. Equation (2.6) describes the dynamic relationship between real output and the component variables of the MCI. Intuitively, the real interest rate should have a negative impact on real output, since an increase in real interest rates decreases investment spending. A real depreciation of the yuan (a decrease of e) should lead to an increase in the net exports, since the domestic goods become cheaper than foreign goods. Thus, the sum of α_3 is expected to be negative, and so is α_4 . The overall effect of credit is expected to be positive, as increase in loan supply would increase aggregate demand via the credit channel.

To make a statistically adequate empirical model in the form of equation (2.6), we employ the general-to-specific (Gets) approach associated with Sargan and Hendry. This approach has been applied to determine the lag structure for single equation time series modelling. The procedure of this approach is as follows. First, we start with a large model with lots of variables, which is statistically adequate, and is known as a general unrestricted model (GUM). This model should include all variables that may affect the dependent variable, and can capture the essential features of the data generation process (DGP). Second, extensive diagnostic tests are conducted to restrict and rearrange the model to arrive at a parsimonious final formulation. Those regressors, which are statistically insignificant, would be knocked out of the model. The final, acceptable model should have regressors that are uncorrelated with the error term, and should have stable parameter estimates over the sample period.⁹

Although the GUM is in favour of a ‘large’ model, too many explanatory variables and lags would substantially reduce the degrees of freedom. Therefore, we have to introduce some limit on the list of the candidate regressors. For each independent variable included in the model, we check up to eight lags to determine the lag structure of the model, as it is believed that monetary policy takes around two years to affect the ultimate targets. For the dependent variable, we search up to four lags, as almost all the studies on MCI using IS-based models are first-order or second-order autoregressive models. The general-to-specific variable deletions are conducted by the automatic model selection function in the software *PcGets* based

⁹See Brooks, 2008, p. 191. A ‘parsimonious’ model here refers to a small model which can explain all of the results of a larger model, e.g. parsimonious encompassing.

on the information criteria including Akaike Information Criterion (AIC), Hannan-Quinn Criterion (HQ), and Schwarz Information Criterion (SIC).

A necessary step prior to the general-to-specific approach is to ensure that the original model satisfies the assumptions of the classical linear regression model (CLRM).¹⁰ Consequently, we consider two actions to address potential violations of the CLRM. First, we test the stationarity of the time series of the variables, i.e. by unit root tests. The OLS regression analysis applies when the variables are stationary, or $I(0)$. If the problem of nonstationarity were not properly addressed, the OLS estimate would generate spurious results. Following standard time series econometric practice, we conduct both the Augmented Dickey-Fuller (ADF) tests and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. We present the results in Table 2.3. The number of lags selected in the tests is based on the Schwarz Information Criterion (SIC). In the ADF tests, for all the series, the null hypothesis of unit roots with an intercept can be rejected at the 5 per cent significance level. In the KPSS tests, all the series are stationary. Thus, we treat all the series as stationary, and consider the OLS estimate to be valid.

Variables	ADF Test			KPSS Test		
	No of lags	t-statistic	p-value	t-statistic	5% level	10% level
y	1	-3.001	0.0348	0.154	0.463	0.347
r	5	-3.118	0.0252	0.339	0.463	0.347
e	7	-4.271	0.0006	0.424	0.463	0.347
$credit$	2	-5.019	0.0000	0.307	0.463	0.347
y^*	5	-4.450	0.0002	0.0957	0.463	0.347

Notes: (1) ADF and KPSS test equations include a constant; (2) number of lags selected is based on the Schwarz Information Criteria; and (3) ADF: testing the null hypothesis of a unit root; KPSS: testing the null hypothesis of stationary.

Table 2.3: ADF and KPSS unit root tests

To ensure the validation of the CLRM referring to structural changes, we include dummy variables in the model. Considering the potential impacts of the institutional evolutions in China's money and financial market, we propose three dummy variables into the model: $D1$, $D2$ and $D3$. These variables are intended to represent the effects of the following crucial reforms: the unification of the dual exchange rate regime in 1994Q1; the abolishment of the credit plan in 1998Q1; and the implementation of a managed floating exchange rate regime in 2005Q3.

The empirical estimates are reported in Table 2.4 given by *PcGets*. Note that the regressors of foreign demand, and the dummy variables $D1$ and $D2$ are knocked out

¹⁰See Brooks, 2008, p. 193.

Variables	
constant	3.2465*** (0.7169)
y_{t-1}	0.6198*** (0.0712)
r_{t-2}	-0.1483*** (0.0339)
r_{t-6}	0.2058*** (0.0353)
r_{t-8}	-0.1052*** (0.0335)
e_{t-4}	-0.0499*** (0.0131)
e_{t-8}	-0.0405*** (0.0132)
$credit_{t-4}$	0.0218** (0.0094)
$D3$	0.6511** (0.3192)
R^2	0.8679
F statistic	63.22**
Durbin-Watson	2.21

Notes:

1. The independent variables are the real GDP growth rate. The estimations are over the full sample period 1987:Q1–2010:Q2.
2. ***, ** and * denote significance at 1%, 5%, and 10%, respectively.
3. The estimated parameters' standard errors are in the parentheses.

Table 2.4: Estimates of the IS-based model

of the model according to the information criterion, due to their insignificant role in the model. The real interest rate with two, six, and eight lags enters significantly in the model. The real exchange rate enters with four and eight lags. The credit growth enters only with four lags. It is important to note that such a lag structure is largely determined by the data themselves, rather than economic theories. Therefore, the model closely fits the sample of data in the analysis. In addition, the switch from a fixed exchange rate regime towards a managed float regime enters significantly. The model does not suffer a severe serial correlation problem due to the DW statistic.

The sum of the lagged coefficients of the real interest rate, real exchange rate, and new credit is -0.048 , -0.090 , and 0.022 , respectively. The numbers suggest that a one point change in the real interest rate has only half the impact on aggregate demand of a one per cent change in the real exchange rate, but has twice the impact of a one per cent change in the new credit/GDP ratio. The IS-based equation provides a straightforward, convenient way to derive the weights in constructing the MCI. To obtain comparable estimates from another method, we estimate a VAR model with the same regressors, but without the dummy variables.

2.3.3 *VAR-based model*

A second approach we use to construct the MCI for China is to consider an unrestricted vector autoregression (VAR) in variables included in the IS-based model. The weights required to calculate the MCI are based on the cumulative impulse responses of output to shocks of those component variables over several years.¹¹ A characteristic of the VAR approach is that all the variables are treated endogenously, instead of being set by predetermined static structural equations. Consequently, it allows for indirect impacts of those component variables on aggregate demand.¹² For example, a rise in the interest rate may affect output via the effect on investment; it may affect output also via the channel of domestic currency appreciation. In the IS-based model, this issue is not properly addressed. In addition, more dynamics are allowed in the VAR model, with restrictions only from statistical techniques.¹³

As shown in Table 2.3, the non-stationarity is not an issue in any of the time series; therefore, the standard VAR model is appropriate rather than a vector error-correction model (VECM). Consider a simple, standard VAR model, which incorporates all the variables in the IS-based model except the dummies:

$$z_t = A_1 z_{t-1} + A_2 z_{t-2} + \cdots + B y_t^* + u_{z_t} \quad (2.7)$$

¹¹See Batini and Turnbull, 2002.

¹²See Goodhart and Hofmann, 2001.

¹³See Lütkepohl, 2007.

where y_t^* is the external demand, which is set to be an exogenous variable; z_t is a vector of four endogenous variables, $(y_t, r_t, credit_t, e_t)'$; A_1, A_2, \dots, B are coefficient matrices, and u is the serially independent residual for the corresponding variable. We treat y_t^* as an exogenous variable of the economy within China, which is supported by the Granger Causality tests in Table 2.5.

To address the identification problem, we use a standard Cholesky variance decomposition, with the ordering $(y_t, r_t, credit_t, e_t)$. To examine the robustness of the model, we run the decomposition using different orders. The estimated results of the IRFs show no significant differences, which suggests that the ordering of the variables in the variance decomposition is not an important issue. Two lags are included in the model according to the SIC.

The responses of output to one-unit shocks of the variables in the system are reported in Figure 2.6. The impulse response functions are consistent with economic theory: a positive shock to the real interest rate and real exchange rate leads to a negative response of the output, and the effects are significant in the first 6-8 quarters. Meanwhile, a positive shock to the credit variable causes a positive response of output; however, the response appears to be small and insignificant. This is probably because it takes some time for the monetary policy to affect aggregate demand via the credit channel, but we have only two lags in the VAR model. To examine this issue, we re-estimate the model by extending the lag number to different values from three to eight. Accordingly, the size of the response tends to increase, but it remains insignificant, probably due to the decreasing degrees of freedom.

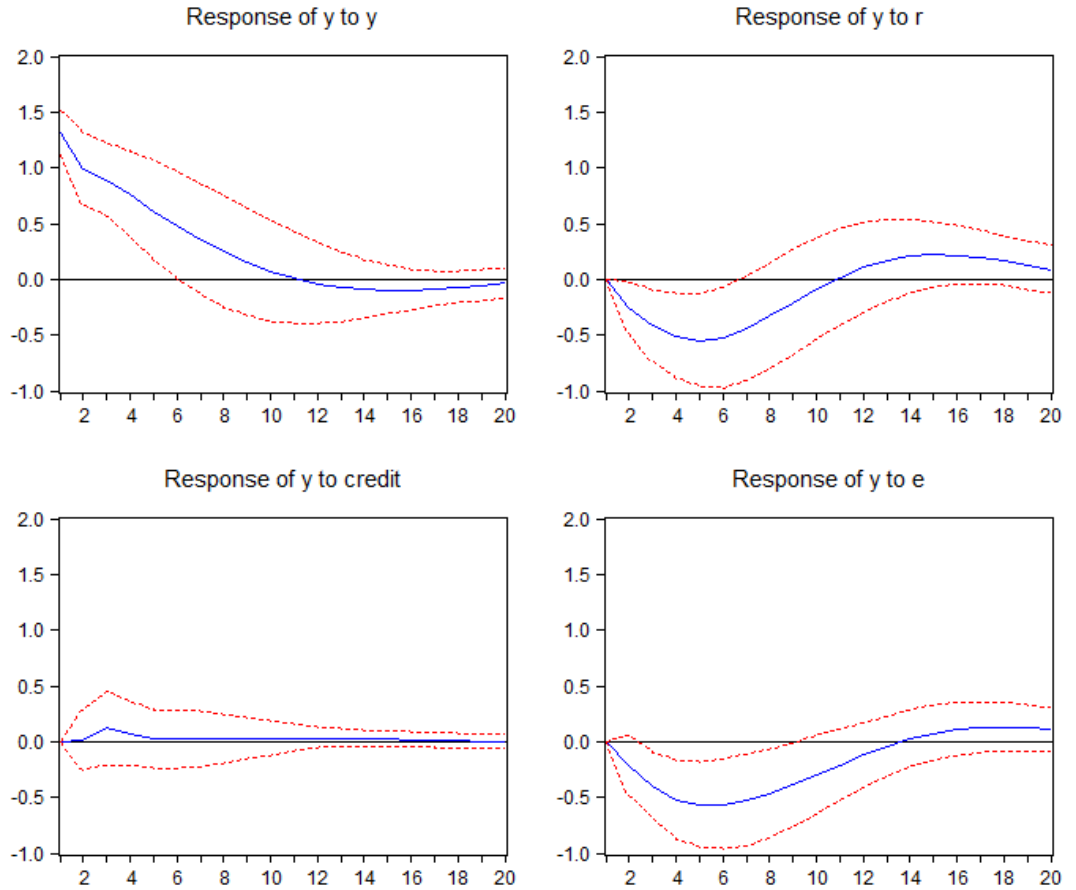
Interestingly, the impulse responses in Figure 2.6 suggest a less important role of the bank credit, but a more important role of the real interest rate in influencing output. In the past years, the shadow banking system has largely weakened the PBC's capacity to control credit through unregulated loans. While the PBC relies heavily on the banks to control credit and interest rates, it leaves residents and private enterprises few and unattractive choices: the former find it extremely difficult to access formal banking sector, while the latter are suffering from a negative real deposit rate. Residents are then seduced to withdraw their money and deposit it with high-yielding shadow banks. According to one report of Financial Times in 2011, the unregulated shadow banking system supplied more credit to the economy than formal banks did.¹⁴ Besides the non-bank credit from the shadow banking system, the PBC is facing difficult task in managing the regulated loans in the formal banking sector. When the PBC said the high level of bank lending needs to an end, state banks which are driven by higher profits may not take it seriously. One example was in 2010 when banks overshot the new loan target the PBC set at the start of the year by about 450 billion yuan. As the PBC finds itself largely at the mercy of the shadow

¹⁴See "Cracks in Beijing's financial edifice", Financial Times, October 9th 2011.

Null hypothesis:	F-statistic	Prob.
y does not Granger Cause y_t^*	0.6658	0.5164
y_t^* does not Granger Cause y	2.4447	0.0926
r does not Granger Cause y_t^*	0.8975	0.4112
y_t^* does not Granger Cause r	1.0366	0.3589
$credit$ does not Granger Cause y_t^*	0.9510	0.3903
y_t^* does not Granger Cause $credit$	12.0294	0.0000
e does not Granger Cause y_t^*	0.4118	0.6637
y_t^* does not Granger Cause e	1.8670	0.1606

Note: The lag length in the Granger Causality tests is two.

Table 2.5: Granger Causality tests



Notes: (1) The estimations are over the full sample period 1987:Q1–2010:Q2; (2) the Cholesky decomposition ordering is $[y_t, r_t, credit_t, e_t]$; (3) the lag length is two, as suggested by the Schwartz Information Criteria (SIC); and (4) the standard error bands are based on an asymptotic approach, and are denoted by the red dashed lines.

Figure 2.6: Response of output to one standard deviation innovations

banking system and state banks, the monetary controls of the PBC on bank credit is substantially weakened. This, together with the significant influence of the real interest rate on output, calls for a further liberalization of interest rate to enhance the PBC's monetary policy capability. It also suggests that in light of the financial market liberalization, the interest rate seems to be a more feasible target for the PBC than the formal bank credit in serving the function of influencing output.

To see the overall impacts of those variables on output, we report in Table 2.6 the accumulated impulse responses of y_t to the shocks of r_t , $credit_t$, e_t over twenty quarters. The accumulated impulse responses appear to be stable after 8–12 quarters, so we calculate the MCI weights by looking at the accumulated impulse responses over 8 and 12 quarters after the shock, respectively. After 8 quarters, the responses to real interest rate, real exchange rate, and new credit are -3.0635 , -3.4503 , and 0.3029 , respectively; after 12 quarters, the responses are -2.8758 , -4.0818 , and 0.4126 , respectively.

Period	y_t^*	y_t	r_t	$credit_t$	e_t
0	-0.0205 (-0.0349)	1.2401 (0.0914)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
1	-0.0498 (0.0589)	2.1693 (0.2065)	-0.2428 (0.1009)	0.0143 (0.1193)	-0.2018 (0.1210)
2	-0.0966 (0.0826)	3.0063 (0.3304)	-0.6373 (0.2381)	0.1302 (0.2403)	-0.5809 (0.2395)
3	-0.1403 (0.1070)	3.7190 (0.4836)	-1.1227 (0.3972)	0.1996 (0.3470)	-1.0778 (0.3745)
4	-0.1775 (0.1303)	4.2939 (0.6589)	-1.6412 (0.5666)	0.2202 (0.4463)	-1.6145 (0.5257)
8	-0.2729 (0.2008)	5.4555 (1.4189)	-3.0635 (1.2432)	0.3029 (0.8020)	-3.4503 (1.1242)
12	-0.2691 (0.2206)	5.4290 (1.9496)	-2.8758 (1.7051)	0.4126 (0.9261)	-4.0818 (1.4595)
16	-0.2297 (0.2074)	5.0713 (2.082)	-2.0926 (1.7752)	0.4895 (0.8735)	-3.7692 (1.4675)
20	-0.2089 (0.1892)	4.9037 (1.9633)	-1.7037 (1.5433)	0.4974 (0.7958)	-3.3445 (1.3022)

Notes: (1) The estimations are over the full sample period 1987:Q1–2010:Q2; (2) the Cholesky decomposition ordering is $[y_t, r_t, credit_t, e_t]$; (3) the optimal lag length is two as suggested by the Schwartz Information Criteria (SIC); and (4) the estimated parameters' standard errors are in the parentheses.

Table 2.6: Accumulated impulse response of the output

2.4 Properties and Interpretations of the MCIs for China

Following the standard method, we summarize the underlying estimates from the IS-based model and the VAR model in Table 2.7 after normalizing the parameter of the real interest rate as unity. All the signs of the weights are consistent with the economic theory we mentioned earlier. It can be seen that the estimated weights appear to be slightly different based on various empirical approaches. For example, the weights in the IS-based model suggest that a 1 percentage point rise in the real interest rate is equivalent to a 1.90 percentage appreciation of the Chinese currency, or a 0.46 percentage decrease in the new credit/GDP ratio, in terms of the effect on the aggregate demand. The weights based on the VAR model suggest less prominent roles for the exchange rate and the credit variable in influencing the aggregate demand.

Following the definition in equation (2.5), we arbitrarily choose 2001Q1 as the base period, which may be regarded as China's recovery year from the 1997 Asian Financial Crisis emerged.¹⁵

Type of the MCI	θ_r	θ_e	θ_{credit}
IS-based	1	1.8952	-0.4570
VAR-based (8 quarters)	1	1.1263	-0.0989
VAR-based (12 quarters)	1	1.4194	-0.1435

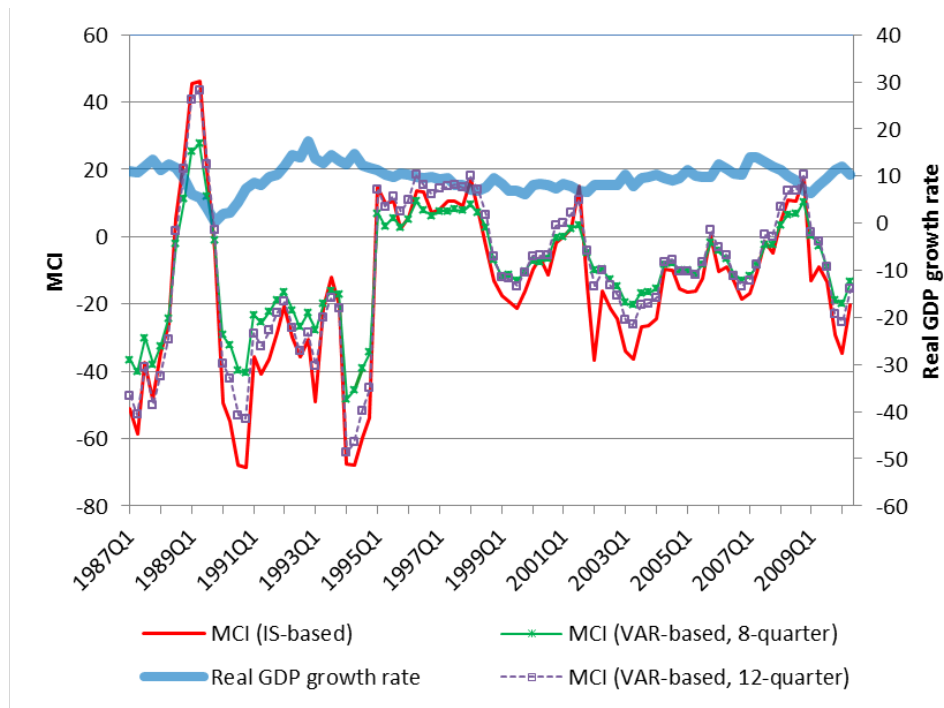
Table 2.7: Estimated weights for the MCI

2.4.1 A glance at the MCI

In order to make some visual examinations, all the three MCIs are plotted in Figure 2.7. It can be seen that the IS-based MCI fluctuates more widely than the VAR-based MCIs, and the two VAR-based MCIs overlap with each other. All three MCIs look similar in appearance, and seem to exhibit the same peaks and troughs over the entire sample period. All the MCIs suggest tough monetary conditions emerged in the years 1988-90, 1997-98, 2001-02 and 2008. Meanwhile, there were expansionary monetary conditions in the years 1990, 1994, 2003, 2006, and 2010.

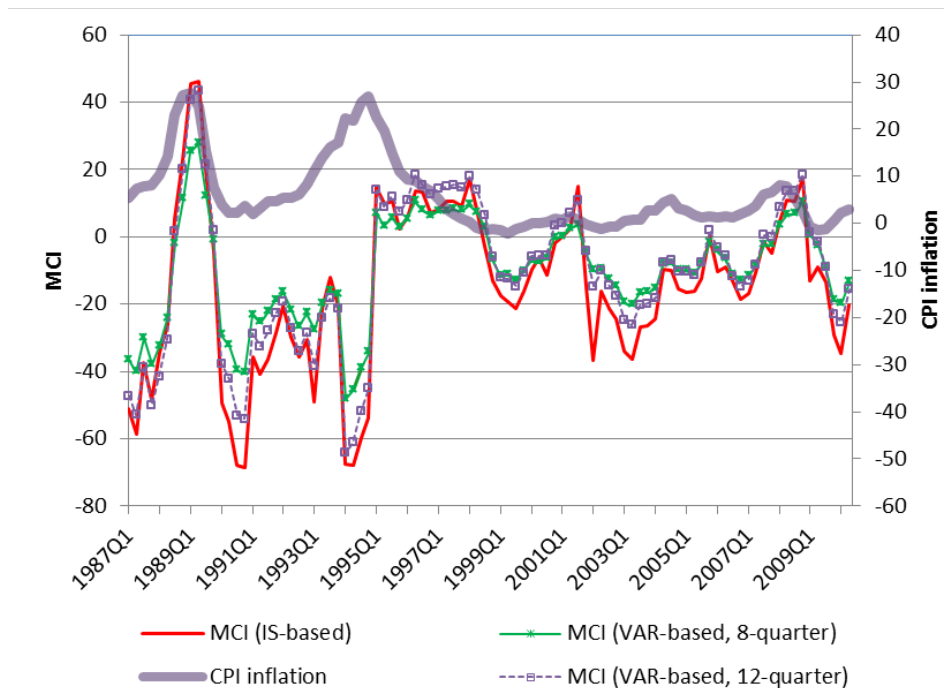
In order to examine whether the MCIs have any leading implications for output growth, we plot real GDP growth together over the same period. Figure 2.7 shows that the MCIs appear to reach the peaks (contractionary monetary conditions) or

¹⁵To check the robustness, we replace the real primary lending rate with the real one-year deposit rate. The IS-based MCI ratio is 1:1.1013:0.1994; the VAR-based MCI ratio (8-quarter) is 1:1.1681:−0.1373; the VAR-based MCI ratio (12-quarter) is 1:1.0456:−0.0886. All those ratios exhibit no significant differences from the ratios using the real primary lending rate. So our construction of the MCI is robust to the choices of interest rates.



Notes: (1) 2001Q1 is set as the base period. (2) MCI (IS-based) uses the weights from the IS-based model; MCI (VAR-based, 8-quarter) uses the weights from the accumulated impulse responses over eight quarters in the VAR-based model. MCI (VAR-based, 12-quarter) uses the weights from the accumulated impulse responses over twelve quarters in the VAR-based model.

Figure 2.7: MCIs and the real GDP growth: 1987Q1–2010Q2



Notes: (1) 2001Q1 is set as the base period. (2) MCI (IS-based) uses the weights from the IS-based model; MCI (VAR-based, 8-quarter) uses the weights from the accumulated impulse responses over eight quarters in the VAR-based model. MCI (VAR-based, 12-quarter) uses the weights from the accumulated impulse responses over twelve quarters in the VAR-based model.

Figure 2.8: MCIs and the CPI inflation: 1987Q1–2010Q2

troughs (expansionary monetary conditions) two to six quarters in advance of the corresponding changes in real output, which are measured by the 4-quarter growth rate. This can be regarded as evidence of the leading-indicator property of the MCIs, which effectively capture the business cycle in China. For example, the turning points of the MCIs are matched by the upturns of real output growth in 1987–88, 1991–92, 2001–03, and 2009–10, and by the downturns of real output growth in 1989–90, 1993–97, and 2007–09.

Similarly, we check whether the MCIs we derived are informative on future inflation. As Figure 2.8 shows, all the MCIs perform more effectively as the leading indicator of CPI inflation than they do in forecasting the future output, as the turning points of CPI inflation are clearly predicted in advance. For example, the upturns of inflation in 1987–89, 1991–94, 2003–05 and 2007–08, and 2009–10 are all predicted by the downturns of MCIs (expansionary monetary conditions) in 1987, 1990, 2001–03, 2005–06, and 2008–09, correspondingly. Meanwhile, the downturns of inflation in 1989, 1995, 2001, 2005, and 2008 are also predicted by the upturns of the MCIs in 1988, 1994, 2000, 2004, and 2007, correspondingly.

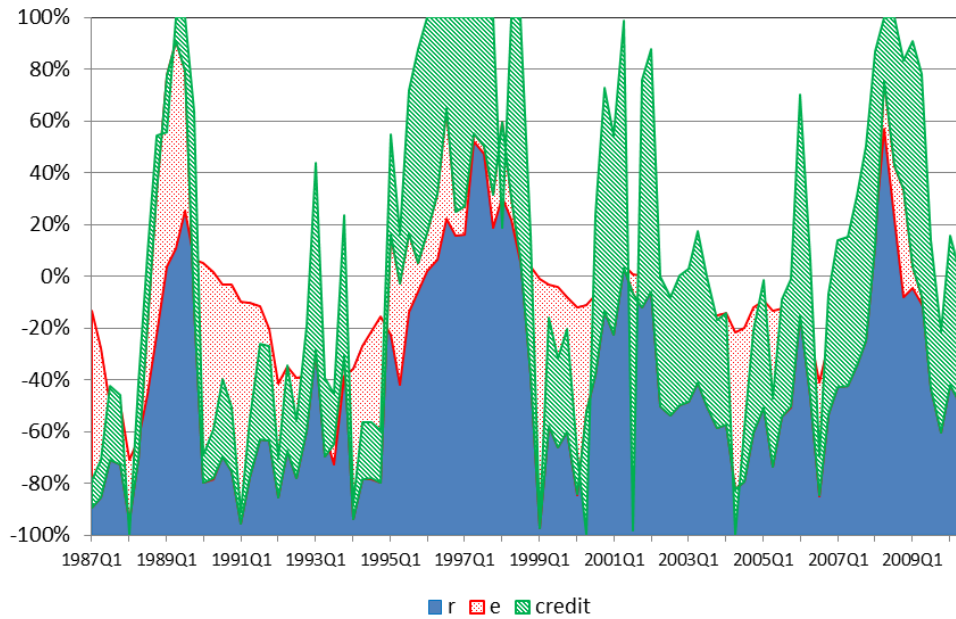


Figure 2.9: Contributions of the component variables to the MCI (IS-based)

To illustrate the relative importance of each component variable in the MCI, we follow Bu and Zhou (2004) by calculating their individual contributions to the MCI and plot them in Figure 2.9. It can be seen that the contributions of all three component variables vary significantly over time. For example, the real interest rate became dominant in 1989, 1997, and 2008, and the exchange rate played a crucial role in 1990–91, 1994–95, and 2004. Given the time-variant influences of the real interest rate, the real exchange rate, and the bank credit on the aggregate demand, the MCI we derived which combines all those monetary variables appears to be a

superior indicator than any single component variable does in reflecting the changes in the monetary conditions.

2.4.2 MCIs and PBC's monetary policy actions

From a historical perspective, the monetary conditions in terms of MCIs in Figure 2.7 and Figure 2.8 can be closely related to the consequences of a series of China's monetary policy actions. In the late 1980s, to suppress bank loan expansions for fixed capital formation, the authorities implemented a tightening monetary policy. At the same time, the households were encouraged to save more to reduce demand pressures. The policy was believed to be quite effective, as the expansion of domestic loans for fixed asset investment finally ceased. The new credit/GDP ratio fell sharply from 20.6 per cent in 1987Q4 to 0.9 per cent in 1989Q1. However, the tightening of monetary policy led to the failure in the output growth target, as the real GDP growth dropped to 0.2 per cent in 1989Q4.

When the CPI inflation rose sharply to 13.9 per cent in 1993Q2, the central government and the PBC promptly decided to fight the inflation and financial disorders. Interest rates were increased, and administrative controls including credit controls, business restrictions by local governments and foreign exchange rate controls, were imposed by the State Planning Commission in what was known as The Sixteen Regulations in 1993.¹⁶ The MCIs reverted from the trough in 1993 as a result of the interest rate rises and credit growth falls. In January 1994, as the unification of the RMB official rate and market rate, devaluation of the RMB led to a substantial increase in domestic money supply and an expectation of inflation. Later in 1994Q4, the CPI inflation rose to 26.9 per cent, and the authorities missed their inflation target by almost 15 per cent. In the first quarter of 1994, the authorities implemented a powerful control over the credit supply in the banking system to crack down on the inflation, which substantially pushed up the MCIs.

During the 1997 Asian Financial Crisis, the PBC succeeded in maintaining the currency's value by a series of tough measures, including selling foreign exchange in the market, strengthening the administration of foreign exchange purchases on the capital account, strictly inspecting import payments for authenticity, and adjusting interest rates on foreign currency deposits.¹⁷ Visually, on the MCI curves the peak in 1998Q1 reflects the PBC's policy actions. In addition, there were no dramatic swings observed in the MCIs series. The evolution of the MCIs during and after the Asian Financial Crisis suggests a significant contribution of China's monetary policy to the stability of the monetary conditions and to the Asian economic recovery after

¹⁶See Guo, 2002, p. 52.

¹⁷See Xie, 2004.

the crisis.¹⁸ In order to stimulate the economy, the PBC actively increased credit supply and cut interest rates. In late 2001, the MCIs stopped rising and exhibited a downturn, which reflected the effectiveness of these stimulatory policy measures.

The increasing MCIs from 2002 reflected the tightening of monetary policy to curb inflation, in terms of the increase in interest rates and the slowdown of the credit growth. The effects of these tightening policy measures were quite remarkable: at the end of 2004, the growth rate of M2 dropped dramatically to 14.63 per cent from the level of above 20 per cent one year ago. The inflationary pressure was finally brought under control.¹⁹ In 2007Q3, the PBC declared a switch of the monetary policy stance from a ‘neutral’ one to a ‘moderately tight’ one, and later to a ‘tight’ one. During 2006Q2 and 2008Q2, the reserve requirement ratio was raised by 9.5 per cent in order to manage excess liquidity. Meanwhile, to avoid a white-hot growth of the national economy, the one-year deposit rate and the primary lending rate were increased by 1.62 and 1.35 per cent, respectively. The rises in the MCIs during 2006–08 reflected fairly well such a tightening policy stance.

In 2008Q3, the PBC announced a ‘moderately loose’ monetary policy due to the negative impacts of the international financial crisis and domestic natural disasters. The easing policy was designed to stimulate economic growth and implemented through a rapid expansion of bank lending. The new credit/GDP ratio jumped sharply from 7.5 per cent in 2008Q2 to 69.0 per cent in 2009Q1. The corresponding changes in monetary conditions are captured by the sharp decline of the MCIs over 2008Q4–2010Q1. However, such an expansionary effect of monetary policy on the monetary conditions may be partly offset by the negative CPI inflation and the upward pressure on the value of the yuan.

Figure 2.10 plots the MCIs along with the monetary policy change index we constructed in Chapter 1 over the period 1987Q1–2010Q2. Recall that the values -1, 0, and 1 indicate an expansionary change, no change, and a contractionary change in the policy stance, respectively. The figure of the policy change index shows five main phases of tightening monetary policy which are identified using the grey areas: 1988Q3–1989Q3, 1994Q4–1995Q3, 2003Q3–2004Q4, 2005Q4–2008Q2, and 2009Q4–2010Q2. Apparently, almost all the MCI increases emerged within or closely after those five phases (except for the period 1990Q3–1991Q4). In addition, the MCIs respond promptly to the tightening monetary policy, which suggests a strong influence of the PBC’s policy measures. Similarly, the MCIs fall significantly in four expansionary phases of monetary policy: 1990Q1–1991Q2, 1997Q4–1999Q4, 2002Q1–2002Q3, and 2008Q3–2009Q1. Consequently, it seems that the MCIs we derived closely follow the monetary policy actions in China. They can be used for

¹⁸See Guo, 2002, p. 93.

¹⁹See Geiger, 2006.

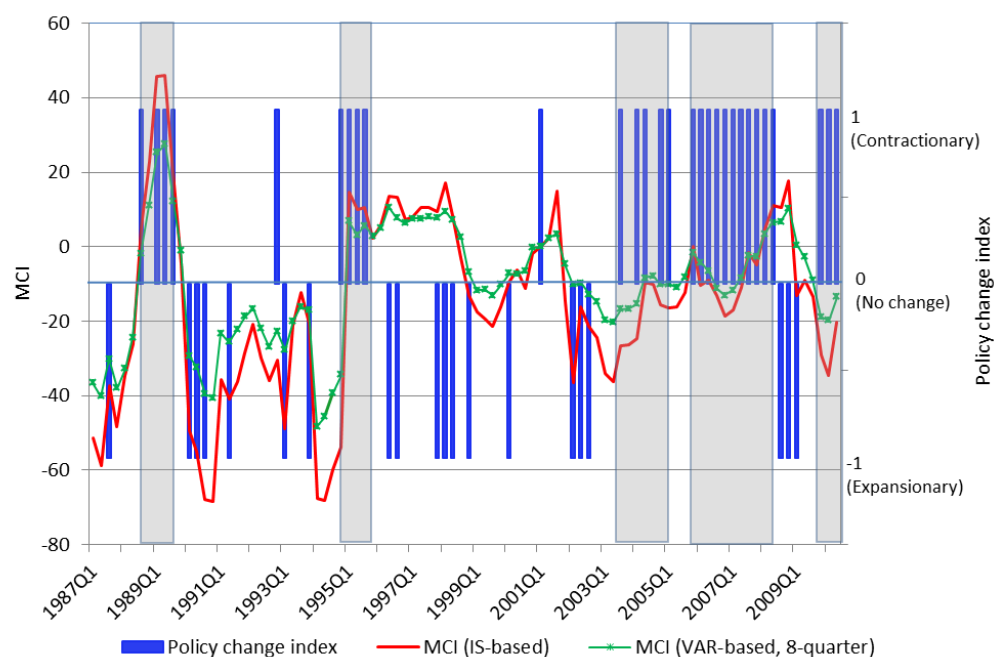


Figure 2.10: Contributions of the component variables to the MCI (IS-based)

the purpose of modelling the monetary policy transmission mechanism, i.e. the short to medium-term impact of monetary policy on the real economy.

It seems unlikely that the MCI is acting as an operational target of the PBC's monetary policy. Indeed, as Figure 2.10 shows, the monetary policy responded to a tightening monetary condition with a loosening policy in 1990Q1, 1997Q4, 2000Q1, 2002Q1, and 2008Q3. When the monetary conditions became expansionary, the monetary policy turned to be contractionary in 1988Q3, 1994Q4, 2003Q3, 2006Q4, and 2009Q4. However, unlike the Bank of Canada and the Reserve Bank of New Zealand in the 1990s, the PBC does not seem to respond to the MCI mechanically. For example, it conducted a tightening policy when the MCIs were already at a relatively high level in 1989Q1–1989Q3, 1995Q2–1995Q3, and 2006Q4–2008Q2. In 1990Q2–1990Q3 and 2002Q2–2002Q3, the monetary conditions were somewhat loose, but an expansionary monetary policy was implemented in any case. Therefore, it is reasonable to infer that the MCI is not an operational target used by the PBC. The central bank does not appear to target monetary conditions only; it may have other types of information or is subject to other considerations beside the MCIs. Given that the policy change index reflects changes in monetary policy directly, then as Batini and Turnbull (2002) suggest the MCI can be used to inform us about the level of the policy stance, for instance, whether the policy has become 'tight' or 'loose' relative to other periods.

Finally, there is another intriguing issue about monetary conditions and monetary policy in China illustrated in Figure 2.10. Geiger (2006) criticises China's monetary policy implementation in the mid-1990s for the low fine-tuning ability of

the authorities. He argues that changes from inflationary to deflationary conditions are somehow too fast. Figure 2.10 appears to support this argument for the period prior to 1995. As we can see, the MCIs move up and down quite drastically and within a wider band. Those changes in the MCIs were accompanied by frequent changes in monetary policy direction. However, after the Central Bank Act was enacted in 1995, the movements of the MCIs become both gradual and mild within a relatively narrow band. One may contribute this to the increasing ability of policy implementation by the PBC in influencing the monetary conditions.

In a word, the MCIs we have derived effectively represent the economic overheating and slowdowns in different years; they also clearly demonstrate the impacts of the monetary policy actions in various cases. The analysis of the MCIs provides a review with a wider range of the setting of the monetary policy and past economic evolutions than broad money supply or the interest rate does alone. More empirical tests about the informative role of the MCIs are implemented in the next section.

2.5 MCIs in Predicting Future Economic Developments

To check if the MCIs are able to predict future economic conditions, there are two conventional methods: in-sample tests and out-of-sample tests. In both tests, we look at the correlations of the MCIs with the future economic growth and inflation. In the in-sample tests, we examine three properties: the cross correlation of the MCIs with the output growth and inflation, respectively; the Granger causality tests from lagged MCIs to the current state of the economy; and, in a bivariate VAR model, the impulse responses of output or inflation to the shocks of the MCIs. In the out-of-sample test, we examine a simple regression to see if a given MCI helps explaining output or inflation some quarters ahead.

2.5.1 *In-sample properties of the MCIs*

Table 2.8 reports the maximum dynamic correlation of different MCIs with the future real GDP growth rate, with the respective lag number when the maximum correlation appears. The correlation of the IS-based MCI with future real GDP growth is -0.492 , and the maximum correlation appears with a lead of three quarters over the real GDP growth rate. The maximum dynamic correlation of the VAR-based MCI with the real GDP growth rate is similar to that of the IS-based MCI: -0.520 (8-quarter) and -0.504 (12-quarter), respectively. The maximum correlations also appear with a lead of three quarters. Those correlations suggest that the MCIs contain significant information about future output growth: a loosening monetary condition boost aggregate demand at quite a short horizon.

	Maximum correlation with future real GDP growth	Number of lags when the max correlation appears
MCI (IS-based)	-0.4918	3
MCI (VAR-based, 8-quarter)	-0.5203	3
MCI (VAR-based, 12-quarter)	-0.5036	3

Table 2.8: Maximum correlation of the MCIs with future output

Table 2.9 shows the maximum dynamic correlation of the MCIs with future CPI inflation. The negative values indicate that a tightening monetary condition is associated with a fall in inflation in the future. The maximum correlation of the IS-based MCI with future inflation is -0.522 , which appears with a lead of six quarters over future inflation. The VAR-based MCIs have slightly larger maximum correlations with future inflation than the IS-based MCI, -0.621 and -0.572 , which appear with five and six quarters leads over the future inflation, respectively. The correlations suggest that the MCIs can also be used as indicators of future inflation: an expansionary change in monetary conditions may be inflationary after five to six quarters.

	Maximum correlation with future CPI	Number of lags when the max correlation appears
MCI (IS-based)	-0.5221	6
MCI (VAR-based, 8-quarter)	-0.6212	5
MCI (VAR-based, 12-quarter)	-0.5718	6

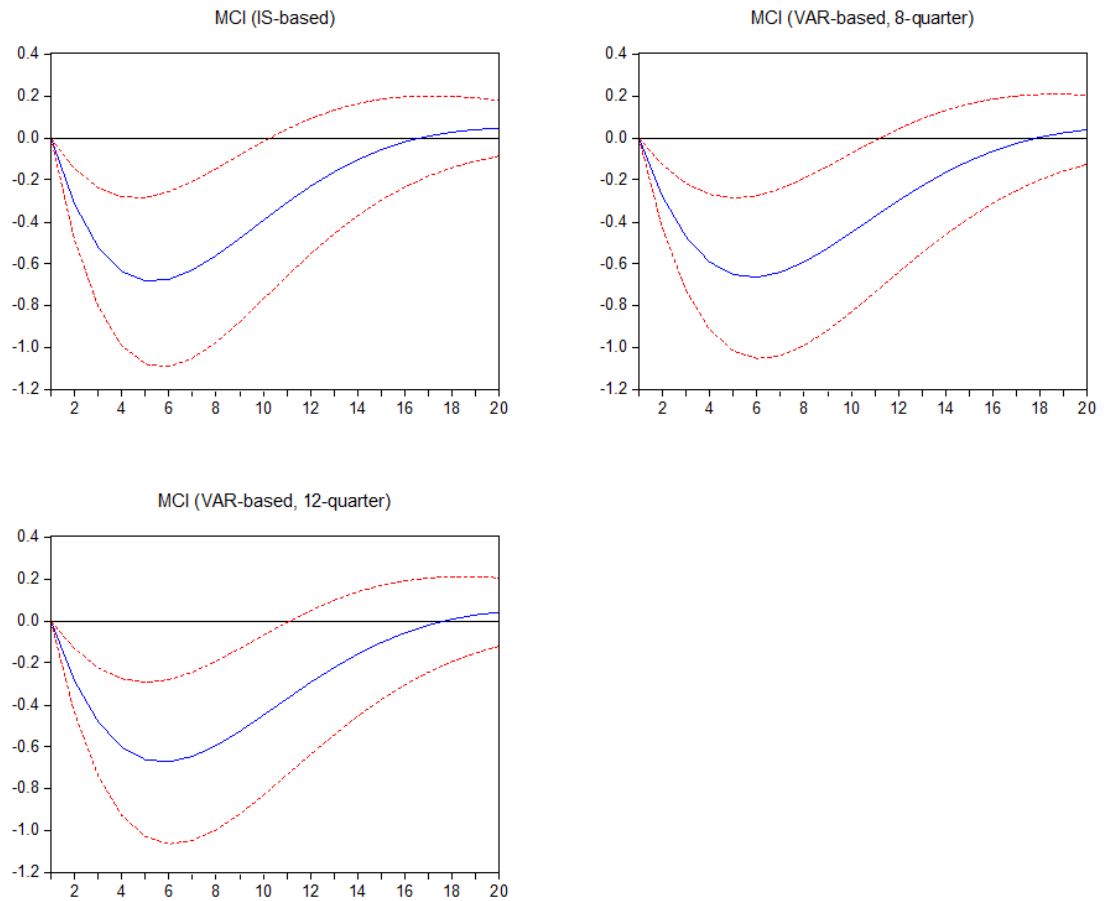
Table 2.9: Maximum correlation of the MCIs with future inflation

According to Table 2.8 and Table 2.9, it seems to take a longer time for inflation to respond to the MCIs than the GDP growth rate does. This is, however, consistent with the conventional understanding of the monetary policy transmission mechanism: an expansion of the money supply, measured by a decline in MCI, leads firstly to an increase in output, and later to an increase in prices. In addition, the maximum correlations of the MCIs with future output are less than their correlations with future inflation. This may provide an interesting policy implication for the government. If the government boosts the aggregate demand by allowing a loosening monetary condition, it may succeed in the short-run probably because prices are sticky. However, such an expansionary policy would raise the rate of inflation in the future. The number of quarters when the maximum correlations of the MCI with future CPI inflation suggest that the demand-side policy leading to a decline in the MCIs would be ineffective in about one year and half.

H0	MCI does not Granger-cause real GDP growth	Real GDP growth does not Granger- cause MCI	MCI does not Granger-cause CPI	CPI does not Granger-cause MCI
MCI (IS-based)	2.5394**	0.9820	3.1256**	3.8260***
MCI (VAR-based, 8-quarter)	2.2159*	1.2613	5.4507***	5.0842***
MCI (VAR-based, 12-quarter)	2.2081*	1.3247	4.3983***	4.9112***

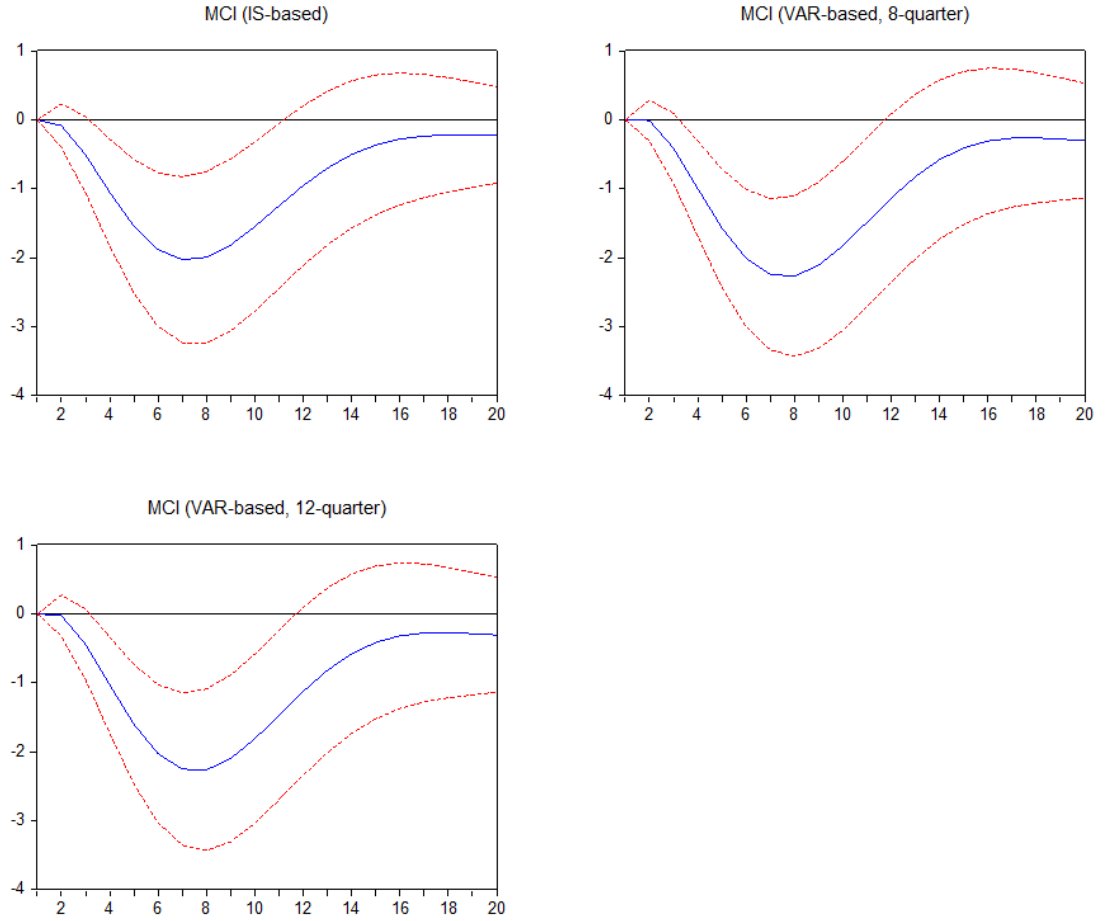
Notes: (1) The values reported are the F statistics; ***, ** and * denote rejecting the null hypothesis at the 1%, 5% and 10% level, respectively; and (2) the tests include four lags.

Table 2.10: Granger causality test for the MCIs



Notes: (1) The estimations are over the full sample period 1987:Q1–2010:Q2; (2) the Cholesky decomposition ordering is $[y_t, MCI_t]$; (3) the lag length is one suggested by the Schwartz Information Criteria (SIC); and (4) the standard error bands are based on an asymptotic approach, and are denoted by the red dashed lines.

Figure 2.11: Response of real GDP growth to one standard deviation innovations \pm standard error of the MCIs



Notes: (1) The estimations are over the full sample period 1987:Q1-2010:Q2; (2) the Cholesky decomposition ordering is $[CPI_t, MCI_t]$; (3) the lag length is one suggested by the Schwartz Information Criteria (SIC); and (4) the standard error bonds are based on an asymptotic approach, and are denoted by the red dashed lines.

Figure 2.12: Response of CPI to one standard deviation innovations of the MCIs \pm standard error of the MCIs

As correlations do not always imply causalities, the correlations reported above are likely to be spurious and misleading. To this end, we carry out Granger causality tests. These tests examine whether MCI causes output (or inflation) by examining how much of the current output (or inflation) could be explained by past values of itself, and then examining whether adding lagged values of the MCI can improve the explanation of output (or inflation). Table 2.10 reports the Granger causality test for the three MCIs. The null hypothesis that the MCI does not Granger cause the real GDP growth rate is rejected at the 10% significance level in all cases. We also reject the null that the MCIs do not Granger cause CPI inflation even at the 5% significance level. So the lagged MCI are believed to contain significant information for future output and inflation.

To further investigate the properties of the MCIs based on different models, we put output and MCI in a simple bivariate VAR model with a lag order of one

suggested by the Schwarz criterion. We use the standard Cholesky variance decomposition with output ordered first and MCI second, and examine the impulse responses of the real GDP growth rate to MCI shocks. Figure 2.11 displays the impulse responses over twenty quarters. For all the MCIs, we find strong and significant impulse responses of output. It takes 4–5 quarters for the output to reach its response peak. The results are robust to other specifications, for example, to different Cholesky order and lag numbers.

For the same purpose, we repeat the procedure by replacing the output with inflation in the bivariate VAR model, with a lag order of two suggested by the Schwarz criterion. The impulse responses of the CPI inflation are plotted in Figure 2.12. For all the MCIs, inflation exhibits strong and significant impulse responses which are consistent with earlier tests. The maximum response of the inflation appears 7–8 quarters after the MCI shock. The results are also robust to other model specifications.

2.5.2 *Out-of-sample properties of the MCIs*

It is argued that some indicators that perform well in the in-sample forecasting may not be good in out-of-sample fits (Goodhart and Hofmann, 2001). Therefore, we proceed to calculate out-of-sample forecasts, and compare the forecasting performances of MCIs based on different econometric models. We calculate the multi-step forecasts from the first period in the forecast sample. Previously forecast values for the lagged dependent variables, i.e. output or inflation, are used in forming a forecast for the subsequent values of output or inflation. Then we use the root mean squared error (RMSE) to measure the forecasting performance in the out-of-sample period.

As future output and inflation may be explained by the information contained in their own past values, we consider the model below. Following Goodhart and Hofmann (2001), we examine multiple steps forecasting in an autoregressive model:

$$y_t = \alpha_1 + \beta(L)MCI_{t-k} + \nu_{1t} \quad (2.8)$$

$$\pi_t = \alpha_2 + \beta(L)MCI_{t-k} + \nu_{2t} \quad (2.9)$$

where y_t is the quarterly real GDP growth rate; π_t is the quarterly CPI inflation; MCI_{t-k} is the MCI under consideration, and k takes the value of 2, 4, 6 or 8; ν_{1t} and ν_{2t} are error terms. The model provides us a simple way to see whether future output and inflation can be explained by the MCI 2, 4, 6 or 8 quarters ahead. The out-of-sample period is set to be 2001Q1–2010Q2.

The process of the RMSE tests can be described as follows. Firstly, we denote the actual and forecast value of output (inflation) in period t as y_t and \hat{y}_t (π_t and

Steps ahead	Parameter on MCI			Root Mean Squared Error		
	MCI(IS- based)	MCI(VAR- based,8- quarter)	MCI(VAR- based,12- quarter)	MCI(IS- based)	MCI(VAR- based,8- quarter)	MCI(VAR- based,12- quarter)
<i>Real Output</i>						
2	-0.0204*** (0.0063)	-0.0300*** (0.0102)	-0.0252*** (0.0545)	1.8254	1.8317	1.8352
4	-0.0105 (0.0071)	-0.0077 (0.0112)	-0.0090 (0.0093)	1.8825	1.8908	1.8895
6	0.0038 (0.0069)	0.0105 (0.0105)	0.0065 (0.0089)	1.9233	1.9033	1.9116
8	0.0028 (0.0066)	0.0075 (0.0100)	0.0051 (0.0085)	1.8335	1.8115	1.8222
<i>Inflation</i>						
2	-0.054*** (0.009)	-0.095*** (0.0125)	-0.0747*** (0.0108)	2.3494	2.2590	2.2904
4	-0.0388*** (0.0104)	-0.0705*** (0.0168)	-0.0530*** (0.0139)	2.6086	2.5850	2.5736
6	-0.0190* (0.0117)	-0.0238 (0.0201)	-0.0225 (0.0160)	2.4604	2.3991	2.4229
8	-0.0032 (0.0106)	0.0064 (0.0175)	0.0005 (0.0143)	2.2813	2.3129	2.2900

Notes:

1. In the forecasting exercise for the output, the dependent variable is the four-quarter real GDP growth rate, the independent variables are the lagged dependent variable and the MCI (2, 4, 6, 8 quarters ahead, respectively), plus an intercept. In the forecasting exercise for the inflation, the dependent variable is the four-quarter CPI inflation, the independent variables are the lagged dependent variable and the MCI (2, 4, 6, 8 quarters ahead, respectively), plus an intercept.
2. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.
3. For the estimated parameters t-statistics are in the parentheses.
4. The root mean squared error (RMSE) is calculated for the dynamic out-of-sample period forecasts over 2001Q1–2010Q2. The forecasting method for the same steps ahead that has the lowest RMSE value is the best forecasting method.

Table 2.11: MCIs forecasting exercise (autoregressive model)

$\hat{\pi}_t$). The forecast sample is set as $j = T + 1, T + 2, \dots, T + h$. Secondly, we calculate the forecast error statistics using the following equations:

$$RMSE_{output} = \sqrt{\sum_{t=T+1}^{T+h} (y_t - \hat{y}_t)^2 / h} \quad (2.10)$$

$$RMSE_{inflation} = \sqrt{\sum_{t=T+1}^{T+h} (\pi_t - \hat{\pi}_t)^2 / h} \quad (2.11)$$

The calculated *RMSE* statistics measure the deviation of the forecast variables from

their actual values, and can be used to compare forecasts of MCIs based on different models. According to the criterion, a lower error suggests better forecasting ability of the model.

Table 2.11 reports the estimation results of the autoregressive model (2.8) and (2.9). When the period ahead extends to cover more quarters, the parameters of the MCIs appear to be less significant and even have unexpected signs; the magnitudes of those parameters decrease substantially. This is probably because the current output depends to a large extent on its own past value after the autoregressive terms are introduced. However, the MCIs can still play a significant role in forecasting output at two quarters ahead, and in forecasting inflation at two and four quarters ahead. The IS-based MCI and the VAR-based MCI (8-quarter) are highly significant at the 1% level when explaining the future output. The estimations in forecasting future inflation show that the MCIs have better performance in forecasting future inflation than in forecasting future output, and the VAR-based MCI (8-quarter) seems to provide the best out-of-sample fits at all quarters ahead, due to its lowest RMSE values.

2.6 Conclusions

The monetary policy conditions index (MCI) has been widely used by many central banks, governments, and financial institutions around the world since the 1990s. The motivation behind constructing the MCI for China is straightforward: the rate of inflation, which is influenced by the level of aggregate demand, is a major concern of the People's Bank of China (PBC); therefore, the PBC should be concerned about the factors which are important in influencing the aggregate demand. Nevertheless, such an indicator for information about monetary conditions is not calculated by the PBC, although it would have become a valuable informational variable for the markets and the general public. To provide a foundation to understand the MCI, I have given a detailed review on the construction of the MCI in theory. Then I have outlined some operational issues by some central banks and institutions in practice.

Conventionally, the monetary conditions index (MCI) combines movements of the interest rate and the exchange rate into a single number. However, the monetary authorities should not forget other channels through which monetary policy affects aggregate demand. To construct an appropriate MCI for China's conditions, I broaden the range of the component variables to incorporate bank credit. Thus, the MCI includes the effect of bank credit on the economy and provides a summary calculation of the overall changes in monetary conditions in China. To assess the relative importance of real interest rate, real exchange rate, and bank credit for the real output, I apply two empirical strategies: the IS equation and the VAR model.

The two methods yield similar weights for the component variables over 1987Q1–2010Q2. In the IS-based model, a 1 percentage point increase in the real interest rate has about the same effects on aggregate demand as a 1.90 per cent increase in the real effective exchange rate, and as a 0.46 per cent decrease in the new bank credit/GDP ratio. In the VAR-based model over 8 quarters, a 1 percentage point increase in the real interest rate has about the same effects on aggregate demand as a 1.13 per cent increase in the real effective exchange rate, and as a 0.10 per cent decrease in the new bank credit/GDP ratio. The estimated weights indicate a prevailing role of the real exchange rate in the determination of aggregate demand.

Since the component variables in the MCI are crucial factors in the determination of aggregate demand, the MCIs may thus serve as a leading indicator of future output and inflation. To investigate the usefulness of the MCIs, I apply both in-sample over 1987Q1–2010Q2 and out-of-sample tests over 2001Q1–2010Q2. The tests show that the MCIs we derived contain important information on future output growth and inflation over the short and medium-term. From a historical perspective, the MCIs reflect the economic overheating and slowdowns in the past decades, and demonstrate the impact of monetary policy actions in various cases. When compared with the monetary policy change index we derived in Chapter 1, the MCIs seem to have different purpose: the latter is less appropriate as the operational target, but more appropriate for characterizing the level of the former.

As a useful indicator of monetary conditions for economic analysis, the limitation of the MCIs should not be ignored. For example, the weights used to construct the MCIs appear to be somewhat model-specific, as the estimates from the IS equation are a bit different from those from the VAR model. Meanwhile, the underlying model's assumptions exclude other potential channels through which monetary policy affects the economy, for example, the channel of asset prices. However, those shortcomings are quite common and apply to most MCIs. To address some of those problems, further studies may derive the weights in the MCI from a large-scale macroeconometric model with more monetary and financial variables. Despite the appealing implications of the MCIs for studies and practice of monetary policy in China, one should be aware of those shortcomings and interpret the MCIs with caution in any case.

FISCAL DOMINANCE AND MONETARY POLICY IN CHINA

3.1 Introduction

Hossain and Chowdhury (2000, p. 126) argue that fiscal policy is a dominant policy instrument of government in developing countries. As the largest developing country in the world, China's fiscal decisions on taxes, deficit and debt not only determine the domestic economy, but also affect the economy globally. In recent years, there has been an increasing emphasis on monetary policy in China, as the People's Bank of China's monetary policy is usually discussed with key macroeconomic variables such as exchange rate, output and inflation. However, China's fiscal policy seems to attract less attention than its monetary policy; in particular, the potential influence on the monetary policy that comes from the fiscal policy is rarely examined, as there is insufficient theoretical or empirical literature about China in this area.

The latest example of a strong impact of China's fiscal policy has been in the wake of the 2008 financial crisis. As an important stakeholder of the international system, the Chinese government embarked on a four trillion yuan (about \$620 billion) fiscal stimulus package in November 2008 and quickly became a source of strength in the financial crisis. To ensure the predetermined target for the economic growth rate will be achieved, monetary policy accommodated fiscal policy by encouraging banks to lend almost at will mostly to state-owned enterprises. Meanwhile, investments were led by the government through infrastructure projects such as the high-speed railway network and airports. As a result of the fiscal stimulus, China achieved an economic growth of 9.1 per cent and 10.3 per cent in 2009 and 2010, respectively. It also made a significant contribution to global economic growth in the aftermath of the financial crisis. While the economic recovery was already underway, China's public debt increased rapidly by 26.8 per cent over 2009–2010. The stock of broad

money M2 increased dramatically by 46.3 per cent in nominal terms. China's annual CPI inflation increased from -0.6 per cent in the first quarter of 2009 to 4.7 per cent at the end of 2010, which exceeded the government's target. Therefore, the threats to China's long-term fiscal sustainability should not be set aside. It is generally argued that fiscal imbalances might play a vital role in maintaining the stability of the economy. Historical lessons from Latin American countries in the 1970s and 1980s demonstrate the damage caused by undisciplined fiscal policies which were attributed to severe inflation and currency problems.

The issue linking the fiscal policy and macroeconomic stability is related to the literature on the fiscal theory of the price level (FTPL) due to Leeper (1991), Sims (1994), and Woodford (1995). The FTPL argues that the intertemporal government budget constraint, which describes the relationship between monetary and fiscal policy, plays a key factor for price determination. The budget constraint is satisfied if the current real value of government liabilities is equal to the present discounted value of the future primary surplus (tax revenues plus seigniorage, minus non-interest expenditures). If the government adjusts the primary surplus to guarantee the government's fiscal solvency, then the price level is determined in the conventional way, i.e. by money supply and demand, which characterizes a Ricardian regime (R, or monetary dominance, MD). On the other hand, if the government determines the primary surplus independently of its real liabilities, then it is the price level that has to adjust to balance the budget constraint, and this is what characterizes a non-Ricardian regime (NR, or fiscal dominance, FD). If there were a non-Ricardian, or fiscal dominance, regime in China, then fiscal policy would provide the nominal anchor. In such a situation, any fiscal changes would impact the price level no matter how committed the PBC was to price stability. The conventional quantity theory of money would become less robust, as any attempts by the monetary authority to fix the money stock would end up causing fluctuations in inflation.

This chapter attempts to examine the role of fiscal policy in explaining inflation and the government budget in China. It draws on early research by Canzoneri et al. (2001a,b) and Daniel (2001), extending their work in three directions. First, we apply a VAR approach proposed by Canzoneri et al. (2001b) to test for the existence of a non-Ricardian regime in China. This exercise, to the author's knowledge, has not previously been carried out for China. Second, we follow Daniel (2001) in considering the role of the central bank's foreign assets in the government's intertemporal budget constraint. Furthermore, we extend Daniel's discussion to include the interest-bearing securities issued by the PBC (central bank bills), which are a critical instrument in the conduct of China's monetary policy. Third, we discuss whether a currency peg is credible in a non-Ricardian regime, and extend the analysis to a scenario where there is pressure for currency appreciation, which fits China's experience since a few years ago.

The chapter is organized as follows. Section 3.2 provides literature reviews on the topics of fiscal dominance and the FTPL. Section 3.3 reviews key economic indicators related to fiscal policy over 1950–2010. Section 3.4 uses the VAR method to distinguish the Ricardian and non-Ricardian regime in China between 1980 and 2010, involving the primary surplus and government liabilities. Section 3.5 considers the role of fixed exchange rates in a non-Ricardian regime and discusses the possibility of their coexistence. Section 3.6 gives the conclusions and suggests directions for future research.

3.2 Literature Review

Many traditional studies of monetary policy have assumed a limited role for fiscal policy in affecting monetary policy.¹ Presumably, the fiscal authority's task is to set the government's budget, while the monetary authority is free to set the path of the nominal money supply or nominal interest rate. There are two characteristics implied by such an assumption. Firstly, the monetary authority can control inflation through its control over the monetary base. Secondly, the seigniorage revenue delivered to the fiscal authority is determined by the monetary authority. Therefore, it is monetary policy that determines the price level, while fiscal policy has to ensure that the bonds issued are backed by the government's future tax revenue. This regime is often described as a traditional Ricardian regime, or traditional monetary dominance (Leeper, 1991; Sargent and Wallace, 1981). Within such a regime, fiscal deficits have no implications for seigniorage or future inflation.

However, some studies have also assumed other types of interaction between fiscal and monetary policies. Sargent and Wallace (1981) and Aiyagari and Gertler (1985) discuss the situation in which there is an active fiscal policy and a passive monetary policy. The key assumption of the policy regime they describe is that the fiscal policy can set current and future surpluses and deficits without regard to any budget balance constraint. When the bonds and taxes are not sufficient to finance government's expenditure, the fiscal deficits have to be financed by the creation of base money. This situation is described as a traditional non-Ricardian regime, or a traditional fiscal dominance (FD) regime. The traditional monetary dominance and fiscal dominance indicate different ways government backs its public debt, i.e. whether the public debt is backed by future fiscal surplus (the monetary dominance)

¹Walsh (2003, pp. 144–45) points out that, open market operations (OMOs) by the central bank, which are considered as the monetary policy instrument, can alter the holding of public debt held by the private sector. Such a change in the composition of public debt held by the private sector and by the monetary authority has implications for future fiscal policy, i.e. the stream of taxes needed to finance the government debt service. Thus, monetary policy has a potential fiscal side to it. However, the impact of monetary policy on fiscal policy is beyond the scope of this chapter.

or by future money creation (the fiscal dominance). Aiyagari and Gertler (1985) indicate that in a traditional monetary dominance regime, any changes in the stock of debt play no role in the determination of the price level; they imply only the adjustment of taxes in the future. But in a non-Ricardian regime, new bonds issued imply a faster money growth in the future. So the proportion of public debt backed by money has exactly the same impact as money itself, and the stock of debt plays a role in the determination of the price level.

The two types of interactions between the monetary authority and the fiscal authority mentioned above share one common feature: at least, one of the two authorities must be responsible for balancing the government's budget constraint. There is, however, a third possibility: neither monetary policy nor fiscal policy adjusts to balance the government budget. In this context, the equilibrium price level would adjust to make the present value of current and expected future government surpluses inclusive of the seigniorage revenue equal to the government's real liabilities inclusive of the monetary base (Woodford, 1995). This situation is known as the fiscal theory of the price level (FTPL), in which the fiscal authority determines the equilibrium price level and thus provides the nominal anchor for the economy. Note that in the literature on FTPL the definitions of the Ricardian and non-Ricardian regime have changed somewhat, because the fiscal authority and the monetary authority are considered together as a consolidated sector. Therefore, the primary surplus consists of fiscal surplus and seigniorage revenue, and the total government liabilities consist of government bonds and the monetary base. In the framework of the FTPL analysis, the Ricardian regime requires a sufficient primary surplus for the government's intertemporal budget constraint to be satisfied; the non-Ricardian regime, or the fiscal dominance regime, indicates an exogenous process determining the primary surplus without any concern for the level of government liabilities.

In recent literature, the FTPL is examined extensively (Buiter, 1999; Canzoneri et al., 2001a,b; Christiano and Fitzgerald, 2000; Cochrane, 1998; Daniel, 2001; Sims, 1994; Woodford, 1995). One argument made in the FTPL is that, without the help of the intertemporal government budget, the monetary authority may not be able to pin down the unique equilibrium price level; thus, the quantity theory of money as a theory of price determination would not be valid (Woodford, 1995). This argument arises from the multiple equilibrium price levels. Conventionally, the nominal interest rate is defined by the Fisher equation in a forward-looking way, as the real interest rate plus expected changes in the price level. In a money demand function in terms of the nominal interest rate, the equilibrium price level becomes an endogenous variable, because it appears in terms of both current and future values. Given the multiple equilibria, an additional equilibrium in the intertemporal government budget constraint may pin down the unique equilibrium price level. Such an equilibrium price level picked out by the fiscal policy may be independent of nominal

money supply (Woodford, 1995; Walsh, 2010, p. 162). However, Buiter (1999) argues that the intertemporal government budget constraint should be satisfied for all price levels, not for the equilibrium price level only. He thus argues that the FTPL has serious flaws, and emphasises that not all of real public spending, real net revenue and real seigniorage can be fixed endogenously.

The implications of fiscal dominance for the equilibrium price level may jeopardise the monetary authority's ability to control inflation through the monetary base. In a traditional fiscal dominance regime, monetary policy must react to ensure that the government's intertemporal budget is balanced. Thus, monetary policy faces certain constraints imposed by fiscal policy. This situation is described by Leeper (1991) as active fiscal and passive monetary behaviour. In particular, Sargent and Wallace (1981) discuss a paradox for monetary policy under the fiscal dominance regime. If the public's demand for government bonds has an upper limit, the monetary authority is then unable to prevent the fiscal deficits being monetized once the upper limit has been reached. In this situation, any tightening of monetary policy today to fight inflation may cause a higher deficit. Eventually the deficit financing will require higher seigniorage revenue which ends up with a higher inflation tomorrow. So this 'unpleasant monetarist arithmetic' reminds us that monetary policy could be linked to fiscal policy. The existence of fiscal dominance may reduce the effectiveness of monetary policy which makes a low inflation policy unsustainable: 'Friedman's list of the things that monetary policy cannot permanently control may have to be expanded to include inflation' (Sargent and Wallace, 1981). Fry (1998) also discusses about the fiscal dominance and central bank independence in some developing countries. He argues that central bank independence in those countries is determined by both the size of the government's deficit and the methods by which it is financed.

In the case of the FTPL, the failure of the conventional quantity theory of money indicates a less important role for monetary policy or the monetary rule (Woodford, 1995). If the monetary authority targets the nominal interest rate, given that the equilibrium price level is determined by the fiscal factors, the nominal money supply would vary proportionally with the price level. If the monetary authority targets the nominal money supply, the nominal interest rate is determined by the fiscal factors. In particular, when the monetary authority fixes the money supply, the equilibrium price would be proportional to the level of government debt, and would be unrelated to the nominal money supply (Walsh, 2003, p. 171).

A number of studies have tried to look for empirical evidence of fiscal dominance in country-specific studies. As discussed earlier, one characteristic of traditional fiscal dominance is that monetary policy is forced to accommodate fiscal policy. So if monetary policy is subordinate to fiscal policy, a fiscal deficit would be positively

related to an increase in the money supply. Aiyagari and Gertler (1985) examine the proportion of government debt that is backed by fiscal policy, and regard the proportion as a measure of the extent to which monetary policy accommodates fiscal policy. So the fiscal regimes can be indexed by the estimated value of this proportion. De Resende (2007) rewrites the expression for the equilibrium price level obtained by Aiyagari and Gertler, and examines the long-run dynamics of nominal money stock, consumption, and public debt. The proportion of the debt backed by the fiscal authority can then be identified from the parameter on the stock of the debt. De Resende makes a panel study on OECD countries and some developing countries and concludes that developing countries have a higher degree of fiscal dominance than OECD countries. Melitz (1997) examines the cases of 15 European Union countries and some OECD countries for the period 1960–95. He argues that an easy fiscal policy leads to a tightening of monetary policy. This finding can be regarded as evidence to support the existence of monetary dominance in those countries. Favero (2002) indicates that in the euro area for the period 1980–99, the deviations of fiscal policy from fiscal rules do not cause any modification of the policy of the monetary authorities. Favero and Monacelli (2003) look at the regime in the US during 1960–2000 and identify traditional monetary dominance after 1987. They argue that during the period 1960–87, it is possible to identify time windows where an empirical model based on both monetary and fiscal regimes is able to track the dynamics of inflation better than a regime based on a monetary rule only.

Instead of examining the traditional non-Ricardian regime, Tanner and Ramos (2002) follow Bohn (1998) to adopt a vector autoregression (VAR) based approach to distinguish between monetary dominance and fiscal dominance. They argue that if the primary surplus, which excludes interest payments on government's outstanding debt, responds positively to an innovation in liabilities (government bonds plus money supply), then the regime should be characterized as one of monetary dominance. The government will cut its future deficits when its liabilities rise. This test is called backward looking, because it focuses on the outstanding debt stock of yesterday. Tanner and Ramos evaluate the policy regime in Brazil for the period 1991–2000 using monthly data. They conclude that there is little evidence favouring a monetary dominance regime during the period, as the primary surplus does not respond to shocks to the government's liabilities.

However, both Canzoneri et al. (2001b) and Tanner and Ramos (2002) argue that fiscal dominance would also have produced the positive correlation between the primary surplus and liabilities, with a causation going from the former to the latter. Consider a positive primary surplus innovation in a fiscal dominance regime. Continual adjustments in the price level must occur for the government intertemporal budget constraint to be balanced. The transmission channel to the price level works as follows: aggregate demand is depressed by an innovation to the surplus,

which in turn lowers the price level. The falling price level raises the real government liabilities to balance the increase in the primary surplus, which results in a positive relationship between the primary surplus and real liabilities. Thus, the backward looking approach cannot distinguish between monetary dominance and fiscal dominance. In addition, Canzoneri et al. argue that even in a monetary dominant regime the primary surplus does not necessarily have to respond to the level of debt ‘infinitely often’; a discrete response of the primary surplus once every decade or every century would be enough.

Given the shortcomings of the backward looking approach, Canzoneri et al. (2001b) propose a forward looking way to test the relationship between current primary surplus and future liabilities. They also adopt the VAR approach to perform the test. When the primary surplus is not negatively serially correlated, then in a Ricardian regime, there should be a negative impulse response of the total government debt to an innovation in the primary surplus. In other words, a positive innovation to the primary surplus would be used to pay off the real liabilities in a Ricardian regime. If the primary surplus does not adjust, the regime is then defined as a non-Ricardian one. Using annual data for the US over 1951–95, they argue that a monetary dominant regime provides a more plausible explanation of the impulse responses of liabilities. Increases in the surplus are associated with declines in current and future real liabilities, given that the surplus does not display negative serial correlation. The evidence by Tanner and Ramos (2002) for Brazil during 1991–2000 shows that the current surplus innovation fails to explain future liabilities. Their conclusion suggests fiscal dominance in Brazil, which is consistent with that of their backward looking approach. Using both the backward looking and forward looking approaches, Zoli (2005) finds evidence of fiscal dominance in Argentina during the 1990s and early 2000s.

In addition, some studies of the implications of fiscal dominance are extended to issues of exchange rate regimes. Kopits (2000) reviews the crisis episodes in emerging-market economies with a pegged exchange rate regime in the 1990s. He suggests that a lack of fiscal rules in terms of sizable government deficits renders those economies vulnerable to currency crises under high capital mobility. Daniel (2001) argues that in a two-country world an exchange rate crisis is caused when the fiscal authority allows the present value of primary surpluses (including seigniorage) to deviate from the value of government debt at a pegged exchange rate. Canzoneri et al. (2001a) also look at a stochastic two-country model with representative households, and argue that the government needs to guarantee a discipline of monetary dominance for any sequence of exchange rates. The interest rate parity condition constrains the monetary authority’s choice of interest rate in a pegged exchange rate regime: inflations are expected to converge in the two countries, and the domestic interest rate is dictated by the foreign interest rate. So the monetary authority cannot match

the interest rate and, at the same time, deliver seigniorage revenue for fiscal policy to balance the budget constraint. They imply that a currency peg is not credible in a fiscal dominance regime without the help of the fiscal policy. The implications of the fiscal regime for the exchange rate regime are especially important to China, which has effectively pegged its currency to the US dollar in the past three decades. However, the literature on relevant topics for China is fairly limited.

3.3 An Overview of Key Indicators Related to Fiscal Policy: 1950–2010

To understand how fiscal policies affect the economy in China, we need to look at the medium and long-term development in its fiscal system, and in some key fiscal indicators. In this section, we explore China’s fiscal developments and policy issues over the past sixty years. In particular, we look at four aspects: the fiscal deficit, government revenue and expenditure, and the budget structure. Note that a series of fundamental economic and political reforms has taken place since 1978, the role of the strictly central-planned economy has become less prominent since then, but the fiscal and monetary authorities inevitably inherited some patterns from this period. So our overview starts from 1952 when the People’s Republic of China was just founded, and ends in 2010, less than two years after the latest global financial crisis in 2008. While the period 1952–1978 provides us with a historical background on Chinese fiscal policy, we pay more attention to the second half of the period starting from 1980 when the economy has been increasingly characterized as a market economy.

3.3.1 *Government balance*

The government balance-to-GDP ratio we present is calculated as the consolidated budgetary surpluses or deficits of the central and local governments divided by annual nominal GDP, which is widely used as a measure of fiscal expansion. Figure 3.1 presents the evolution of both the budget balance/GDP ratio and the primary surplus/GDP ratio over 1952–2010.² Before 1980, the budget balance fluctuates dramatically, particularly around the years 1960, 1967 and 1979. Later, after 1980, the fiscal deficits persisted in a somewhat moderate way until the Asian Financial Crisis broke out in 1997. From the beginning of 2002 on, there was a solid improvement in the budget balance. As a result, the increasingly lower deficits turned into a surplus in 2007, the first surplus since twenty-two years before. From 2008 on, the balance declined sharply again; at the end of 2009, the deficit accounted for more than two per cent of the total annual GDP. In the past six decades China has experienced

²The primary surplus is defined as the government revenue minus government expenditure, plus interest payment of government debt.

tremendous political and economic changes; the country was even involved in warfare on several occasions.³ It is thus not surprising to see dramatic changes in China's economic and fiscal performance particularly prior to 1980. As the figure shows, the number of large swings became much smaller thereafter. However, the size of both the fiscal balance ratio and the primary surplus ratio is moderate, with a minimum value of -4.9 per cent, a maximum value of 1.6 per cent, and an average of -0.8 per cent. Compared with some other countries, the average fiscal balance/GDP ratio of China during 2005–09, at -0.4 per cent, is at a fairly moderate level.⁴

Conventionally, government can use fiscal policy instruments to stabilize economic growth. For example, during a recession the government may either increase its spending or cut taxes to get the economy to start growing, and it can do the opposite when the economy grows too quickly. Figure 3.1 shows the balance ratio with real GDP growth rate. We can see that the movements of the ratio can be roughly categorized into three phases based on the relationship of the two variables: from 1952 to 1978, from 1979 to 1995, and from 1996 to 2010. Between 1952 and 1978, and then between 1996 and 2009, there seems to be a positive correlation between the fiscal balance and output growth. However, the correlation is less clear from 1979 to 1995.⁵

In fact, such an observed relationship is consistent with the process of China's fiscal policy reforms. Prior to 1978, the fiscal system was highly centralized at the national level, and aggregate output could be well controlled through the setting of output targets for SOEs. Only the government expenditure acted as the main fiscal policy instrument, playing a redistributive role by shifting resources between industries, sectors and geographic regions.⁶ Because of this central-planning system, neither the monetary policy nor the fiscal policy was able to play any role in stabilizing aggregate demand, in the way that they would have done in a market economy.⁷ However, it is reasonable to believe that the large fiscal deficit in 1960 was partly due to disaster relief efforts during the Three Years of Natural Disasters 1959–61, and partly due to the negative impacts on China's economy of the split between China and the Union of Soviet Socialist Republics (USSR). Real output fell dramatically, and millions of people died of hunger. Meanwhile, the average level of government expenditure during 1959–61 was 28.5 per cent higher than one year before the Natural Disasters took place. Nevertheless, dramatic movements in real GDP of this period, as Figure 3.1 shows, were mainly attributed to frequent political

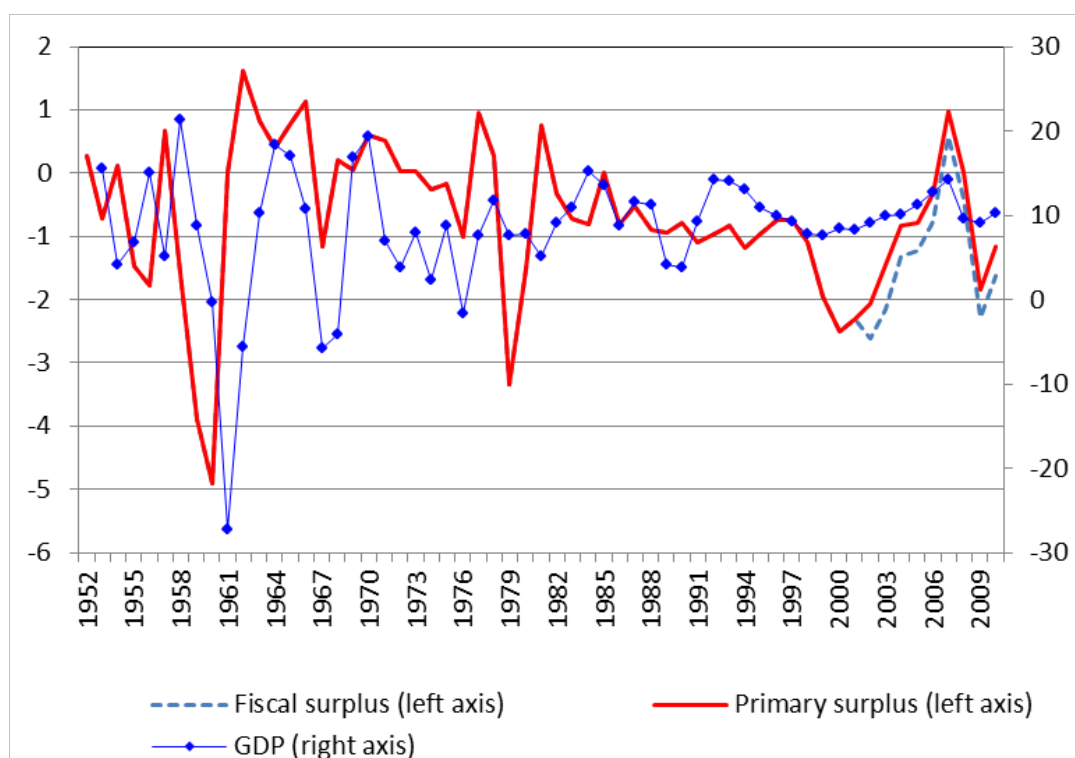
³This includes the Korean War during 1950–53, the Sino-Indian War in 1962, and the Sino-Vietnamese War in 1979.

⁴According to the IMF, during 2005 and 2009 the average gross operating balance/GDP ratio in U.S., U.K, Germany and Japan was -2.6 , -3.16 , -0.13 and -0.5 , respectively.

⁵The correlation between primary surplus and GDP growth rate is 0.04 from 1952 to 1978, 0.03 from 1979 to 1995, and 0.78 from 1996 to 2010. Between 1952 and 2010, the correlation is 0.003.

⁶See Blejer et al., 1991.

⁷See Chow, 2002, pp. 126–27.



Source: author's calculation; China Economic Information Network (CEIN); the DataStream.

Figure 3.1: Government Balance as Percentage of GDP and real GDP growth rate (Previous year=100)

instabilities. For example, the Great Leap Forward during 1958–60, which was at the same time as the Three Years of Natural Disasters, was about a radical and unrealistic economic and social plan which was intended to boost rapid economic growth and shift China from an agrarian economy to a modern communist society within several years. Another typical example is the Cultural Revolution during 1966–76 which brought disastrous consequences to the entire country with long-lasting effects. Therefore, given the evidence that the fiscal balance ratio responded to several extreme values of real output growth, it is possible to suggest that over this period the latter essentially dominated the former. This view is consistent with Blejer et al. (1991) who point out that the fiscal deficit over this period was determined by the quantitative output and investment targets set out in the plan.

By 1977, the country had returned to normal from the state of disorder when the Cultural Revolution ended. During the period 1979–95, the national economy was substantially restored and then experienced rapid development. One of the most notable changes was that budget deficits were allowed to be financed by domestic sales of Treasury bonds. Another significant feature over this period was an enhanced role for the People's Bank of China (PBC) as a central bank. Commercial lending operations were shifted from the PBC to four specialized banks and a universal bank.⁸ The PBC could then conduct its monetary policy by imposing credit ceilings

⁸The four specialized banks are: the Bank of China (BOC), the People's Construction Bank of

on these banks, in what was known as the Credit Plan. Apart from that, the PBC also used direct lending to the specialized banks as its monetary policy instrument. The direct lending was originally designed to maintain structural and socioeconomic development by filling the gap between bank deposits and credit plan targets. It was also used to manage the overall bank liquidity through the granting of short-term credit.⁹ However, this institutional arrangement provided opportunities for financing budget deficits indirectly via the PBC's direct lending to finance various projects in agriculture, infrastructure or energy sectors.¹⁰ Such a fiscal responsibility, supposed to be a burden of the fiscal authority, had shifted to the monetary authority. Thus, regardless of the contribution of the PBC's direct lending, the link between fiscal deficits and changes in aggregate demand may be blurred during 1979–95.

Since the Budget Law was enacted in 1994, there have been significant improvements in China's fiscal system. Then in 1995, the Central Bank Law was launched. The former contains strict provisions on budgetary procedures and expenditure management.¹¹ The latter prohibits the PBC from financing either central or local government fiscal deficits.¹² As a result, the outstanding amount of borrowing by the Ministry of Finance (MOF) from the PBC dropped sharply from 158.2 billion yuan in 1993 to 113.2 billion yuan in 1995, and remained almost unchanged thereafter. Nevertheless, in the new fiscal and monetary system, meeting the economic growth plan through aggressively increases in infrastructure spending remained a prominent goal of fiscal policy. Given its obligation to achieve a certain target growth rate, the fiscal authority was challenged by the pressure of economic slowdown and deflation in both 1997 and 2008. It thus made enormous demands on the fiscal budget, as shown in Figure 3.1 there was a trough of the fiscal balance/GDP ratio in 1999–2002, and later another one in 2009. A lot of infrastructure projects were financed by massive government spending, which effectively supported economic growth, offsetting sharp falls in export sectors. Especially in 2009, when the world was still in the shadow of the international financial catastrophe, a record massive fiscal stimulus package of four trillion yuan was announced by Premier Wen Jiabao. In that year, China achieved an impressive GDP growth rate of 9.1 per cent. After the substantial increase in government expenditure, the fiscal deficit ratio remained relatively modest at 2.6 per cent and 2.3 per cent in 2002 and 2009, respectively. Such figures

China (PCBC), the Industrial and Commercial Bank of China (ICBC), and the Agricultural Bank of China (ABC).

⁹See Tseng et al., 1994.

¹⁰See Ma, 1997, pp. 19–20.

¹¹See Tseng et al., 1994.

¹²According to the Central Bank Law, Article 28: "The PBC must not allow the government to go overdrawn or directly subscribe to or act as sole sales agent for State bonds and other government bonds." And according to Article 29: "The PBC must not provide loans to the local governments, governmental departments of various levels, non-bank financial institutions and other organizations or individuals except to non-bank financial institutions specially permitted by the State Council. PBC must not act as financial guarantor for any organization or individual."

appear to be reasonable compared with the conventional international standard of 3 per cent.

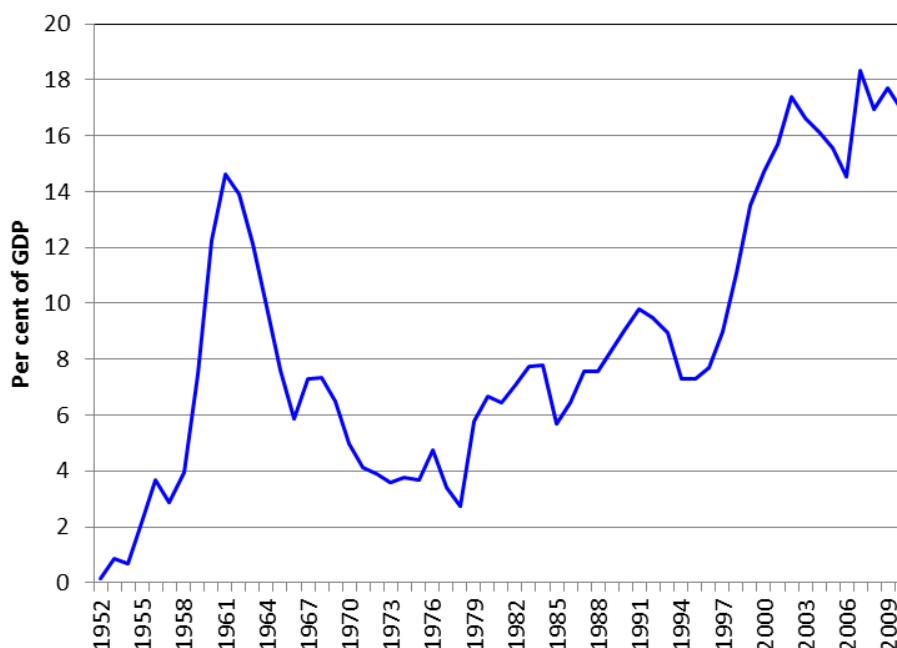
Interestingly, there has been a considerably persist and increasing overall deficit in China. The average fiscal balance/GDP ratio within the three sub periods is -0.3 , -0.9 and -1.4 , respectively. However, it is unclear yet whether changes in the fiscal deficit should be associated with other economic variables, such as future expansions of money supply and inflation fluctuations. Given China's apparent economic growth and moderate inflation rate over the post-reform period, further analyses are required to investigate the issues of potential fiscal imbalance.

3.3.2 Public debt

When the reform took place in 1979, there were no government bonds, bills, or other papers issued. The deficits were financed through borrowing from the PBC directly. The first issuance of treasury bonds was in 1981, with an amount of only 4.9 billion yuan (1.0 per cent of contemporaneous GDP). Given the specific institutional evolution, the calculation of the public debt/GDP ratio in the following analyses varies over time: prior to 1984, the debt figure is the accumulated government deficits since 1952; after 1985, the debt is calculated as the sum of outstanding treasury bonds of the government. We choose the year 1985 as a break point because the issuance of treasury bonds in the first several years was a trial version. Therefore, the amount of treasury bonds during 1981–85 cannot represent actual size of outstanding government debts. Figure 3.2 plots the combined general government debt-to-GDP ratio from 1952 to 2009.

Most of the public debt expansions, as shown in Figure 3.2, are closely related to large government spending shown in Figure 3.3 below since the middle of the 1990s. In the aftermath of two economic slowdowns in 1997 and 2008, the accelerating public debt/GDP ratio reflected the powerful stimulus to the economy. When there was an economic overheating during 1993–96 and 2004–08, the public debt/GDP ratio exhibited reversals of its previous upward trend. An average of 11.9 per cent over 1985–2010 appears to be moderate. It is noteworthy, nevertheless, that the official debt statistics may be underestimated, because some contingent government obligations are excluded and are not fully disclosed to the public: for example, the off-balance sheet liabilities of local government, and the contingent liabilities to the central government of some public entities like the Ministry of Railways. According to the reports in the Financial Times in 2010, the estimated actual public debt/GDP ratio, including all the contingent liabilities, could be as high as 80 per cent.¹³

¹³The Financial Times (28th March, 2010, "China warned of growing 'land loan' threat") quotes estimates of the public debt/GDP ratio for 2010 as calculated by various sources, for example, 80 per cent by Standard Chartered, and 71 per cent by Victor Shih from Northwestern University in



Source: Author's calculation; China Economic Information Network (CEIN).

Figure 3.2: Public Debt as Percentage of GDP

Although this figure was well above China's official statistic, it may not be entirely shocking, as the conventional standard of a healthy debt/GDP ratio is 60 per cent. For example, the gross debt/GDP ratio in 2009 was 68.2 per cent in the U.K, 83.2 per cent in the U.S, 80.8 per cent in India, and 217.7 per cent in Japan.¹⁴

What has caused the clear upward trend of the public debt/GDP ratio after 1978? The first reason may come from a low ratio of government revenue to GDP compared with other countries. Although China has rapid economic growth, its general government revenue was only 19.3 per cent of total GDP in 2007. In the same year, the numbers for U.S, U.K, Japan and Germany, according to the statistics by IMF, were 32.2, 42.6, 35.2 and 43.8, respectively. In some developing countries, the number was as high as 42.4 in Congo, 24.1 in Vietnam, 44.8 in Hungary, and 28.1 in Egypt. With a much lower government revenue-to-GDP, China's fiscal capacity appears to be relatively weak, even weaker than some developing countries. On the other hand, the task of stimulating economic growth requires the government to make public spending more dynamic. Therefore, to finance its budget deficit by issuing large numbers of government bonds became a preferable choice for the government in practice. As a result, the outstanding public debt rose sharply after 1995 once the Budget Law and Central Bank Law were enacted.

Secondly, the accelerating public debt/GDP ratio since 1994 can be associated with the changing relationships between government, SOEs and banks. Before 1994,

the US.

¹⁴See IMF Fiscal Monitor by International Monetary Fund, 2010.

there was a lack of sound fiscal and monetary disciplines. Under the pressure of the central government, specialized banks had to offer considerable loans to SOEs which carried the burden of some state functions. This resulted in a sharp rise in non-performing loans (NPLs) which could be viewed as an increase in the contingent liabilities of the government. Once the fiscal discipline was enhanced, the intervention from the government was weak. It became difficult for the government to support SOEs via bank loans. Instead, the government had to depend largely on bond issuing to help those SOEs, or to pursue any other macroeconomic stabilization purposes. In addition, as the reforms of SOEs progressed, the burdens of social stability and welfare once provided to the employees were gradually shifted from SOEs to the government budget, for example, operating schools and hospitals. Those changes were expected to enhance SOEs in their profit-making capacity. In 1997, the SOE Bankruptcy Law was enacted, but closing loss-making SOEs remained quite difficult and unpopular in practice.¹⁵ The shift of social responsibilities from SOEs to government placed additional pressures on the government's fiscal resources. As a result, the sum of the government's culture, science and medical expenditure increased from 170.4 billion yuan in 1996 to 450.6 billion yuan in 2003. The amount of SOE employment also declined significantly by 40 per cent between 1996 and 2006, largely as the result of the lay off of workers from SOEs.¹⁶ The proposition that factors related to SOE reforms affects the performance of government debt service may also be supported by the following example. Since 2003, there has been an impressive improvement in the performance of most SOEs in terms of profitability. According to the figure quoted by Ciuriak (2004) from the State-owned Assets Supervision and Administration Commission (SASAC), the number of loss-making SOEs fell dramatically from 474 to 72 in 2004. This significantly improved situation can be linked to the stable movement of the debt/GDP ratio during 2003–05 in Figure 3.2. On average, the real annual growth rate of government expenditure on social security over 2004–06 was 11.6 per cent, much lower than over 1996–2003 with a growth rate of 57.4 per cent.

Last but not least, the mounting public debt may be related to the recapitalization operations which generate explicit government obligations with respect to non-performing loans (NPLs). The structural changes in SOEs and the liberalization of the financial sector are typically two sources of NPLs during the transitional period. As a government-led investment surge normally plays a vital role in economic growth, it also generates the problem of accumulated NPLs in the banking system. Guo (2002, p. 119) summarizes several sources of NPLs, as Table 3.1 shows.

In 1998 when Zhu Rongji became China's premier, he was seriously concerned about the possibility of a crisis caused by the NPLs, so he was determined to fix this

¹⁵See Burdekin, 2008, pp. 144–45.

¹⁶See Burdekin, 2008, p. 145.

Sources	Notes
1 SOEs; agricultural units	Loans granted in the pre-reform system could not be repaid after 1980s.
2 Export industry; consumer product manufacturing	Changes in economic structures, for example the Asian Financial Crisis in 1997. Loans granted to these sectors were not repaid.
3 Commercial banks	Inadequate regulations by the PBC of bank loans.
4 Government	Mismanagement of resources allocation and mistakes in production plans. Loss of profit led to unpaid loans.
5 Borrowers	Mismanagement in their operations and the loans cannot be repaid.

Source: Guo, 2002, p. 119.

Table 3.1: Sources of NPLs

problem. Some of his policies worked in the following way: firstly, the central government issued ‘special financial bonds’ to banks; secondly, with the money the central government recapitalized the same banks which bought those bonds. In the same year, the central government issued 270 billion ‘special financial bond’. As a result, banks had strengthened balance sheets and higher capital ratio from government injection.¹⁷

In order to write off more NPLs, the government set up four asset management companies (AMCs) to absorb NPLs and package them for sale on the market.¹⁸ These AMCs had their assets financed by the PBC (in total amount about 600 billion yuan, equivalent to \$US 72.55 billion) and by issues of AMCs bonds (in total about 800 billion yuan, equivalent to \$US 96.74 billion) (See Bottelier, 2005). The AMCs had their assets guaranteed from the MOF which was responsible for their losses, but were monitored by the PBC prior to 2003, and were subsequently monitored by the China Banking Regulatory Commission.¹⁹ In 1998, about 1.4 trillion yuan (\$170 billion) of NPLs of the four state-owned banks were transferred to AMCs. In 2005, the PBC lent 1.2 trillion yuan (\$150.9 billion) to bail out the AMCs in order to divest NPLs from all commercial banks.²⁰ By 2005, the government had injected 322 billion yuan in bail-outs to fix the NPLs problem.²¹ From 2004 on, the official NPLs statistics reflects sounder balance sheets after cleaning up. As can be seen in Table 3.2, there has been a decreasing trend in the NPLs ratio over 2004–09

¹⁷See Shih, 2008, pp. 170–71.

¹⁸The four AMCs are Xinda, Changcheng, Huarong and Dongfang.

¹⁹See Burdekin, 2008, pp. 146–47.

²⁰See Liew and Wu, 2007, pp. 203–05.

²¹See Shih, 2008, p. 27.

after extensive government bailouts in 2003 and 2005. Nevertheless, by 2005, the AMC's had only disposed of a quarter of NPLs. Moreover, the PBC experienced considerable difficulties in maintaining its tightening monetary policy stance, due to the government's intentions to keep the cost of government borrowing low and to continuously use AMC's to address the NPLs problem.²²

	2004	2005	2006	2007	2008	2009
NPLs (billion yuan)	1717.6	1313.4	1254.9	1268.4	560.3	497.3
Percent of total loans	13.2	8.6	7.1	6.2	2.4	1.6
Percent of GDP*	1.1	0.7	0.6	0.5	0.2	0.1

Note: * estimated by the author using official data.

Source: China Banking Regulatory Commission.

Table 3.2: Nonperforming Loans in China

Note that all the recapitalization operations, which aim to make the banks' books look better in the short run, may make the fiscal position worse in the long run. Although the AMC's recover NPLs from the banks, the bonds the AMC's issue are still backed by the MOF. So the MOF is ultimately responsible for the AMC's bonds even though those bonds do not appear on the MOF's balance sheet. It can be inferred that any difficulties the AMC's encounter would result in considerable pressures on the government's fiscal budget. For example, if there is a slow recovery rate of NPLs managed by the AMC's, or if the amount of NPLs jumps sharply again, interest payments on the bonds they have issued would become a serious problem to the fiscal and monetary authorities. In spite of the doubt on whether the size of NPLs in China is underestimated, the official ratio of NPLs to total loans has fallen continuously to 1.6 per cent in 2009, compared with a number of over 50 per cent a decade ago. It gives an indication of the lower cost of addressing the NPLs problem for the banks; but once again, the main concern about the impact of recapitalization on the fiscal burden is that the less the banks have to pay out on their NPLs, the more the fiscal budget is affected currently and in the future.

The latest example is the expansion of 9,629 billion yuan (\$1409.8 billion) in new loans by the banking system in 2009. The figure was more than double the amount lent one year earlier. Easy credit was encouraged and channelled by the government into infrastructure investment. Although economic growth remained at 9.1 per cent at the year end, potential NPLs have become a hotly debated topic: the loans channelled to many infrastructure projects which have difficulty in generating cash flow may end up as NPLs on banks' books. Those NPLs will increase the hidden debt in the form of off-balance sheet liabilities of local government. A recent estimate by the China Banking Regulatory Commission claimed that in 2009, the outstanding loans to 8,221 funding vehicles set up by local governments had risen to

²²See Liew and Wu, 2007, pp. 203–05.

7.4 trillion yuan (\$1.1 trillion), which was about 20 per cent of all outstanding bank credit in 2009. On 26th July 2010, Financial Times quoted the estimate by HSBC that a minimum of 30 per cent of those bank loans was unlikely to be repaid.²³

One structural feature of government debt issued is that the financial institutions hold more than half of total treasury bonds, while individuals only hold a small amount. Currently, relevant statistics are not announced by the official sources. However, we can consider financial institutions' claims on government, which consist mainly of treasury bonds, as an approximation. Take 2008 as an example, Table 3.3 shows that only about 14.3 per cent of the treasury bonds are held by sectors other than the PBC and the depository corporations. It can be inferred that holdings of treasury bonds by households would be even less than that figure.

Despite the increasing public debt/GDP ratio since 2002, interest expenditure makes up about 0.4 per cent of GDP on average, as Table 3.4 shows. Government bonds in China have a relatively flat yield curve, due to intensive administrative pricing controls, and pervasive interest rate controls.²⁴ Those controls on interest rates keep the cost of government borrowing at a low level. On the other hand, there is insufficient room left for the interest rate to act as an effective monetary policy instrument. In particular, when the PBC intends to conduct a tightening monetary policy, interest payments may become a heavy burden for the fiscal budget if the PBC raises interest rates. In addition, the commercial banks are less interested in purchasing government bonds with long maturities, because of the low yield. Note that most of the treasury bonds are still held by banks, insurance companies, and securities firms, on which the government still has a strong influence.²⁵ The government then allocates quotas of government bonds commercial banks have to buy when those bonds are less attractive.²⁶ So the artificially low borrowing cost may help us to understand why government has tended to borrow more and more in recent years. In addition, unattractive government bonds also explain why the government still needs administrative measures when the PBC conducts open market operations to reduce bank lending.

In brief, the rapid public debt accumulation could be attributed in part to the government's preference for a rapid growth rate of the economy. It can also be explained by the enhanced fiscal and monetary disciplines on the relationships between government, banks and SOEs. Finally, the low cost of debt service provides the government with another incentive to borrow more actively. Of course, there are some other reasons related to other institutional developments since the 1980s. For example, in the first several years of the 1980s, state-owned banks were prohibited from

²³See "Chinese banks face state loans turmoil", Financial Times, 26th July, 2010.

²⁴See Bottelier, 2005.

²⁵See Barth et al., 2009.

²⁶See Liew and Wu, 2007, p. 203.

	Amount (billion yuan)	As a percentage of (1)
1. Outstanding Treasury Bonds Issued	5327.2	100.0
2. PBC's Claims on Government	1619.6	30.4
3. Depository Corporations' Claims on Government	2943.5	55.3
4. Others	764.1 [(1)-(2)-(3)]	14.3

Source: the PBC's website: www.pbc.gov.cn.

Table 3.3: Estimation of Treasury Bonds Holdings in 2008

Year	Interest Payment (billion yuan)	Per cent of GDP
2002	67.9	0.6
2003	96.4	0.7
2004	75.9	0.5
2005	81.5	0.4
2006	97.5	0.5
2007	105.3	0.4
2008	130.5	0.4
2009	149.1	0.4
2010	184.4	0.5

Source: China Economic Information Network (CEIN).

Table 3.4: Interest Payment of Public Debt: 2002–2010

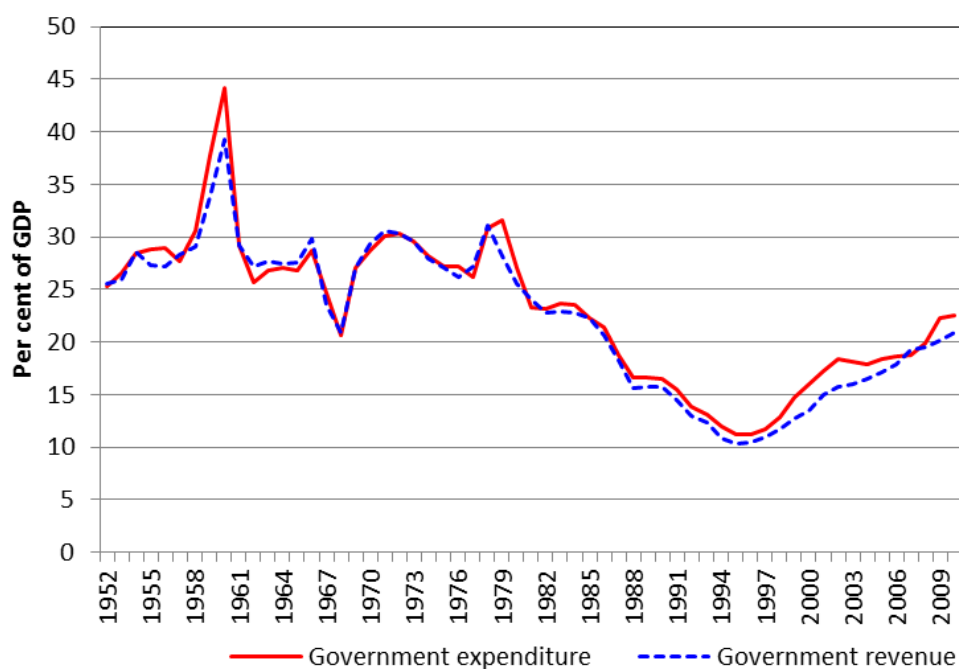
trading government bonds, and individuals and non-bank agencies traded them in unofficial markets; since 1990, a legalized secondary bond market developed rapidly after the opening of stock exchanges in Shanghai and Shenzhen.²⁷ From 2003, reforms on interest rate liberalization have been playing a crucial role in reducing the segmentation of government bond markets.

3.3.3 Government Revenue and Expenditure

One remarkable difference of China's budgetary accounting system compared with international standards is that China treats SOE subsidies as negative revenues rather than expenditures. In order to produce standard comparisons, we make a correction by adding the amount of subsidies on both revenue and expenditure sides. Note that such a modification does not introduce any changes to the fiscal

²⁷See Bottelier, 2005.

deficits analysed earlier. In Figure 3.3, we can see several swings in both revenue and expenditure ratios from the 1950s to the 1970s, reflecting the instabilities in China's political and economic situation in the highly centrally planned system before 1978. As the reforms progressed from the first few years of the 1980s, there were substantial reductions in both the revenue/GDP and expenditure/GDP ratios except in 1985. From 1995, the declining trend was reversed, and both of the ratios had sustained increases.



Source: Author's calculation; China Economic Information Network (CEIN).

Figure 3.3: Government Revenue and Expenditure as Percentage of GDP

The first concern with government expenditure and revenue is their V-shape movements as a proportion of GDP during 1978–2010. On the revenue side, the general decline over 1978–95 is probably due to two causes: reduced profitability of the SOEs as we discussed earlier, and reforms in the tax system since 1985.²⁸ After 1995, the recovery of government revenue was driven by rapid growth in tax revenues, which was a consequence of China's strong economic growth. During 1995–2010, the real growth rate of tax revenue is 14.9 per cent annually on average, compared with 9.4 per cent during 1978–94. On the expenditure side, the movement of the expenditure/GDP ratio follows that of the revenue/GDP ratio. After the Asian Financial Crisis in 1997, the government made tremendous efforts to improve China's social welfare. For example, the government made substantial spending on health and education services, agricultural sectors, and poverty alleviation in the countryside.

²⁸See Wong et al., 1995, pp. 6–7.

Note that two tax system reforms have significantly affected the central government-local government relationship and in turn affect the government's revenue and expenditure patterns. Table 3.5 presents the evolution of the central-local fiscal relationship since the 1950s. In 1985, the government introduced a Fiscal Contracting System to replace the unified revenue collection and unified spending system. Local governments signed contracts with central government (usually for five years) to specify the amount of funds they had to forward to the centre each year. Revenues the local governments collected over or above the agreed amount could be retained in part for local usage.²⁹ In order to explain the sharp decline in the fiscal revenue/GDP ratio during 1978–95 under the Fiscal Contracting System, Qian (2002, p. 320) provides two reasons. First, with the process of decentralization, government had limited information on individuals' incomes and savings, because individuals did not have to present their personal IDs or register their real names when making deposits. So the use of anonymous transactions and financial assets in terms of bank deposits resulted in wealth being hidden from government observation and substantially reduced government taxation. Second, the formal reduction of tax rates was a key reason for the decline of fiscal revenue as a percentage of GDP. Notice that in 1978–95 fiscal revenue still rose at 3.6 per cent annually in real terms on average, but the economy had an even stronger growth than the fiscal revenue, with a real GDP growth rate of 10.1 per cent on average. Consequently, the decline in the fiscal revenue ratio should not be seen as a serious deterioration of government revenue. The Fiscal Contracting System is often criticized on the grounds that most local governments chose to develop the same types of processing industries, which had higher profits. As a result, the government could then collect larger tax revenue.³⁰

Phase	Central-Local Fiscal Relations
Prior to 1979	Unified revenue collection and unified spending
1980–1993	Fiscal Contracting System
1994–Nowaday	Tax Sharing System

Source: Jin et al., 2005.

Table 3.5: Central-Local Fiscal Relations

In 1995, the Tax Sharing System replaced the Fiscal Contracting System. Customs duties, customs-levied VAT, consumption tax and income tax from SOEs are designated as central tax; personal income tax, income tax of locally owned enterprises, urban land use tax and property gains tax are designated as local tax. Three types of tax are to be shared between central and local governments: VAT on

²⁹See Li, 1999, pp. 144–45; Jin et al., 2005. For more details of the tax sharing ratio between the central and different local governments, see Jin, 1994, pp. 132–35.

³⁰See Li, 1999, p. 145.

domestic products, securities transactions tax and resources tax.³¹ The incentives encourage local governments to become more enthusiastic for economic developments in their own areas, because most local taxes are derived from local enterprises other than SOEs. Unlike under the Fiscal Contracting System, local governments turn to prefer investments with low profitability but higher tax rates. However, this also leads to the problem that all local governments tend to develop the same types of industry.³² Another feature of this Tax Sharing System is the incentive for the local government to depend on revenue on the land, which is usually regarded as a main cause of the overheating real estate market in the past decade.

In order to understand some other features related to China's fiscal policy, we take a closer look at the structures of its budget from both revenue and expenditure sides. Table 3.6 reports the revenue structure in percentage of GDP. Clearly, both direct and indirect taxes increased significantly at the same time. The direct taxes were the primary revenue source. Their contribution was larger than indirect taxes during the pre-reform period. During this period, there was no tax on income, and the direct taxes consisted of agricultural taxes only. Meanwhile, there were no business taxes, consumption taxes, or VAT, and custom duties made up all the indirect taxes. The pre-reform revenue structure reflects a remarkable feature of the centrally planned economy with highly limited market-driven commercial activities. In the post-reform period, considerable changes in revenue structure took place, as the role of indirect taxes became increasingly prominent in total tax revenue. In 2009, it was twice as large as direct taxes, at about 10 per cent of total GDP, whereas the ratio of direct tax to GDP was only 4.6 per cent.

In 2001, China became a member of the World Trade Organization (WTO). According to the commitment it made on joining WTO, China substantially cut its import taxes. For example, the industrial products import tax rate was reduced to 11.6 per cent, compared to 30–50 per cent before 2001. The automobile import tax was cut from 70 per cent to 43.8 per cent for cars with an engine capacity of less than three litres. The agricultural import tax was also cut from 30–60 per cent to 15.8 per cent.³³ Despite a rapid growth of custom duties in absolute value, its share in GDP dropped from 0.9 per cent in 1990 to only 0.1 per cent in 2010. In addition, tax on individuals' profit and income became a significant source of tax revenue after 2000, reaching 1.2 per cent of GDP in 2010. On the contrary, agricultural taxes became less influential, falling from 4 per cent in 1950 to 1.4 per cent in 1970, and then to 0.5 per cent, and they were abolished in 2006.

Meanwhile, some interesting features of China's fiscal policy can be seen on the expenditure side of the budget reported in Table 3.7. Before the reforms took place

³¹See Li, 1999, p. 146.

³²See Li, 1999, p. 147.

³³See Guo, 2002, pp. 103–04.

		1952	1960	1970	1980	1990	2000	2005	2010
Direct Taxation	Tax on Income and Profit (Enterprises)	-	-	-	-	3.8	1.0	2.9	3.2
	Tax on Income and Profit (Individuals)	-	-	-	-	-	-	1.1	1.2
	Agricultural Taxation	4.0	1.9	1.4	0.6	0.5	0.5	0.5	-
Indirect Taxation	Business Taxation	-	-	-	-	2.8	1.9	2.3	2.8
	Consumption Taxation	-	-	-	-	-	0.9	0.9	1.5
	Value-Added Taxation	-	-	-	-	2.1	4.6	5.8	5.3
	Custom Duties	0.7	0.4	0.3	0.7	0.9	0.8	0.6	0.1
Enterprises Loss Subsidies		-	-	-	-	3.1	0.3	0.1	-
Others		20.9	36.9	27.6	24.2	8.8	4.2	3.1	6.3
Total Revenue	Total Revenue (Chinese Definition)	25.6	39.3	29.3	25.5	15.7	13.5	17.1	20.4
	Total Revenue (Standard Definition)	25.6	39.3	29.3	25.5	18.8	13.8	17.2	20.4

Source: Author's calculation; China Economic Information Network (CEIN).

Notes: The standard definition of revenue means the Chinese definition of revenue plus the subsidies to loss-making enterprises. In China's budgetary accounting system, enterprise subsidies are calculated as negative revenues rather than expenditures.

Table 3.6: Structure of China's Tax Revenue: as a percentage of GDP

in 1978, infrastructure construction investments were mainly financed by the government, and these were the largest share in total government expenditure. After 1980, increasing expenditures on social welfare became the main source of expenditure. For example, expenditures on both 'Education, Culture, Science and Health' and 'Pension and Welfare' have increased significantly, accounting for 6.6 per cent of GDP in 2010. The profitability of SOEs has improved, as reflected in a decreasing ratio of enterprise loss subsidy to GDP. Price subsidies (mainly on food, meat, oil and cotton) also reduced significantly, from 2.6 per cent of GDP in 1980 to 0.3 per cent in 2010, indicating a transition from a dual-price system towards a market economy. Administration expenditure, on the other hand, has an increasing trend and at 2.3 per cent of GDP in 2010 was the second largest item on the budget expenditure side. Given the increasing ratio of administration expenditure, the insufficient transparency of government administration cost should become a cause of concern. Interest payments only explained 2 per cent of total expenditure, accounting for 0.4 per cent of GDP.

	1952	1960	1970	1980	1990	2000	2005	2010
Agriculture	1.3	6.2	2.2	3.3	1.6	1.2	1.3	2.0
National Defence	8.5	4.0	6.4	4.3	1.6	1.2	1.3	1.3
Infrastructure Construction	6.9	24.3	13.2	7.6	2.9	2.1	2.2	5.6
Subsidies	-	-	-	2.6	2.0	1.1	0.5	0.3
Administration	2.3	2.2	1.4	1.7	2.2	2.8	3.5	2.3
Education, Culture, Science and Health	3.1	6.0	2.3	4.4	4.0	4.4	4.8	4.3
Pension and Welfare	-	-	-	0.4	0.3	1.5	2.0	2.3
Technical Updating	-	0.2	0.7	1.8	0.8	0.9	0.8	0.8
Enterprises Loss Subsidies	-	-	-	-	3.1	0.3	0.1	-
Debt Service	-	-	-	-	-	-	0.4	0.5
Others	3.2	1.4	2.5	1.0	1.1	0.8	1.3	3.0
Total Expenditure (Chinese Definition)	25.3	44.2	28.7	27.0	16.5	16.0	18.3	22.5
Total Expenditure (Standard Definition)	25.3	44.2	28.7	27.0	19.6	16.3	18.5	22.5

Source: Author's calculation; China Economic Information Network (CEIN).

Notes: The standard definition of expenditure means the Chinese definition of expenditure plus subsidies to loss-making enterprises. In China's budgetary accounting system, enterprise subsidies are calculated as negative revenues rather than expenditures.

Table 3.7: Structure of Expenditures as a percentage of GDP

Compared to some other countries, there are some notable features of China's budget structure. Firstly, a revenue/GDP ratio of around 20 per cent in 2010 is close to some developed countries in 2008, for example, the U.S (19.3 per cent), Germany (23.9 per cent), Japan (18.2 per cent), but less than the U.K. (30.3 per cent). However, direct taxes in China account for 4.6 per cent of GDP, which is relatively low compared with 11–14 per cent in euro countries.³⁴ Secondly, indirect taxes generate more revenue than direct taxes after 1990. For example in 2010, while direct taxes were 4.4 per cent of GDP, indirect taxes were 9.7 per cent. The substantial change is largely due to the introduction of VAT which has become an increasingly important tax source. The share of VAT which was 5.3 per cent of GDP in 2010 is, however, still lower than many other countries.

On the expenditure side, high national defence and infrastructure construction outlay are no longer remarkable features in China. The government has a tendency to increase spending on education, which reflects changes in its concerns from purely

³⁴For data on euro countries, see Sturm and Gurtner, 2007.

economic growth to social welfare, as well. However, the government's corresponding spending on culture, science and health, and pension and welfare are far lower than some advanced economies. The weight for interest payments is also low, providing room for the government who may further rely on financing budget deficits by issuing government bonds.

3.3.4 The exchange rate regime

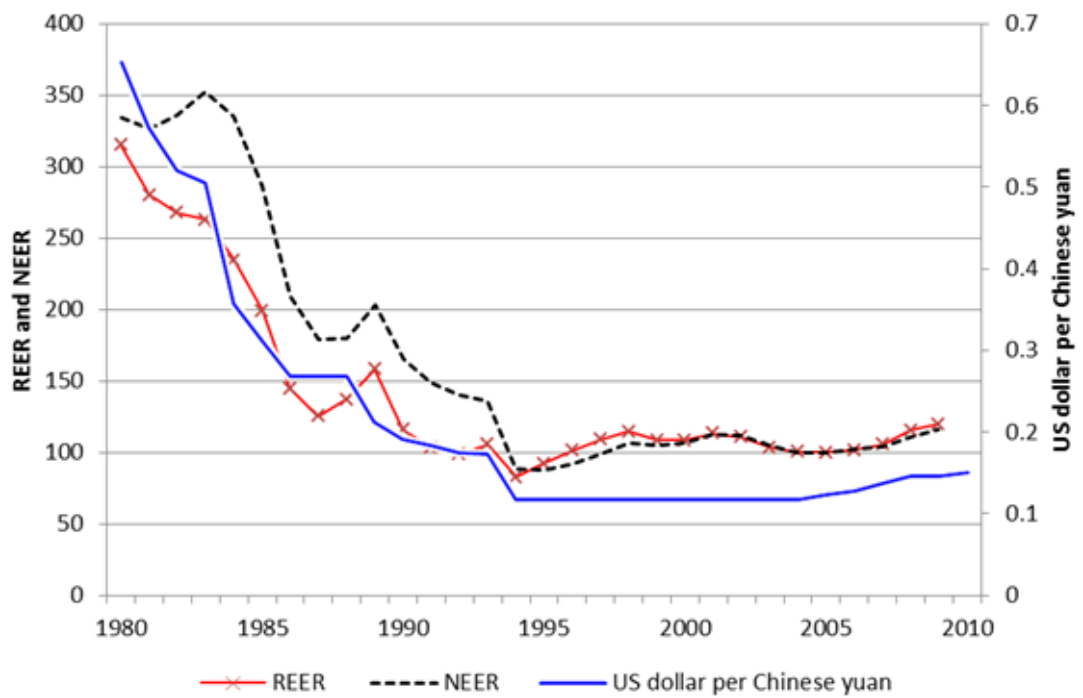
According to the Central Bank Act of China enacted in 1995 (revised in 2003), pursuing currency stability is a primary goal of the PBC's monetary policy. However, the PBC may not be considered as an independent central bank. The Act states that the PBC must be subservient to the decisions of the State Council. According to Article 5 of the Act, all the decisions the PBC made on policies of money supply, interest rates and exchange rate must be reported to the State Council for approval. Thus, the PBC may not be regarded as the key decision maker on the exchange rate. Liew and Wu (2007, pp. 146–59) provide a detailed description of exchange rate policy making in China. In China's policy structure, as for all the other state policies, the supreme decision-making body is the Chinese Communist Party (CCP) Politburo and its standing committee. But in fact the Central Leading Group on Finance and Economics (CLGFE), led by the CCP Politburo, is the most important economic policymaking organ. The CLGFE has members from the CCP Politburo standing committee, so the Politburo's policy preferences have already been taken into account in CLGFE's policy decisions. In practice, the CLGFE depends on the staff of the State Council to undertake the policy work on its behalf. The State Council is responsible for the approval of exchange rate policy suggestions made by the Monetary Policy Committee (MPC) of the PBC.

The PBC has a limited influence on the supreme policy decision making; however, it plays a critical role in implementing the exchange rate policies. The Regulations on Foreign Exchange Management passed in 1996 (revised in 2008), together with the Central Bank Act, give the PBC the power over a wide range of foreign exchange issues. The key department in the PBC responsible for detailed exchange rate policy work is the State Administration of Foreign Exchange (SAFE) which is led by the deputy governor of the PBC. The major responsibilities of the SAFE include: implementing foreign exchange administration under the current and capital account; regulating overseas and domestic foreign exchange accounts; undertaking supervision and management of the settlement and sale of foreign exchange, as well as cross-border capital flows; undertaking operations and management of the state's foreign exchange reserves, gold reserves, and other foreign exchange assets. In addition, the SAFE also provides various statistics and policy suggestions on the exchange rate to the PBC.

One distinguish feature of China's official exchange rate in the past thirty years is the de facto peg to the US dollar, although no explicit target for the bilateral exchange rate has ever been announced by the PBC. Figure 3.4 shows the evolution of various exchange rates during 1980 and 2010. Under the centrally-planned economy regime before 1978, the exchange rate was maintained at a very low level by the authorities, with an average rate of 2.31 RMB/\$US between 1957 and 1977. Then in the early 1980s after the reform took place, the official exchange rate experienced a series of devaluations from 1.53 RMB/\$US dollar in 1980, to 5.75 RMB/\$US in 1993.³⁵ The authorities were more concerned about the effects of devaluation on profits and the competitiveness of China's products. In 1994, in order to gain effective management over foreign exchange supply and demand, the official rate and the swap rate were unified by the authorities. The official rate was initially depreciated to 8.45 RMB/\$US, and was gradually strengthened to 8.28 RMB/\$US later in 1997. This currency peg was strictly maintained for almost a decade. Even during the period of the Asian Financial Crisis in 1997, despite the significant depreciations of Asian currencies, the Chinese authorities chose to stick to the peg so the currency did not depreciate. The strict foreign exchange rate controls were maintained until 2005 when there were increasing complaints about China's exchange rate policy. Some of China's major trading partners, for example, the US, criticised the value of the Chinese currency as an unfair export subsidy, and regarded China's exchange rate policy as the source of global economy imbalances. In the face of those pressures, China's pegged exchange rate was, probably reluctantly, relaxed on July 2005. Although the process of appreciation was temporarily discontinued in 2008, the authorities allowed the currency to appreciate again after June 2009. But the voices urging China to consider a faster currency appreciation became even stronger in the wake of the financial crisis in 2009. By the end of 2010, the rate had appreciated by 19.98 per cent compared with the end of 2004 to reach 6.62 RMB/\$US.

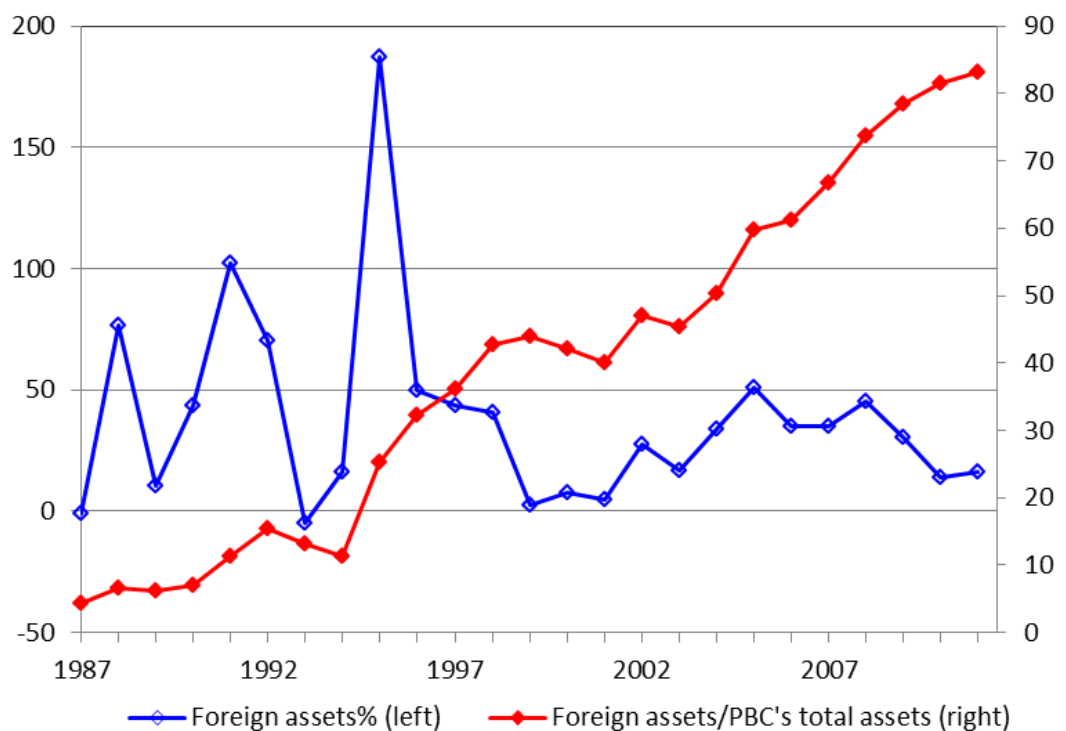
The pegged exchange rate is widely believed to contribute significantly to China's fast economic growth which depends heavily on its export sectors. It helps to make China's products more competitive in international markets. However, given that the pegged rate regime seems to work reasonably well, it forces the PBC to intervene heavily in the foreign exchange market. For example, in order to prevent the renminbi from appreciating, the PBC has to purchase foreign assets in the foreign exchange market through sales of domestic currency. Such intervention has become a typical operation of the PBC since 2002. Figure 3.5 reflects a massive effort by the PBC to prevent the value of the yuan from fluctuations in the foreign exchange market.

³⁵These important reforms on foreign exchange management included the coexistence of the internal settlement rate applying to trade transactions and the official rate from 1978 to 1985; the decentralization of the foreign trade authority; the establishment of the secondary market for foreign exchange in 1980; the licencing of foreign currency swap markets in 1985; and the abolition of quota controls over transaction volumes in the swap market in 1988. See Burdekin, 2008, pp. 14–16.



Source: IFS.

Figure 3.4: Real effective exchange rate, Nominal effective exchange rate, and U.S.-China bilateral exchange rate: 1980–2010



Note: growth of foreign assets % is defined as the annual percentage change in foreign assets.

Source: IFS, the PBC's website.

Figure 3.5: Growth of foreign assets held by the PBC: 1986–2010

In 1986, the PBC had foreign assets of 334.5 billion US dollars, roughly 4.3 per cent of its total assets. In 1992–93, because of China’s huge demand for imports to support domestic economic expansion, the demand for foreign currency rose sharply, leading to a decrease in the nominal and real effective exchange rates, as shown in Figure 3.4. The PBC was forced to sell foreign reserves to resist the pressure of currency depreciation. After the unification of the exchange rates in 1994, the PBC’s foreign assets grew rapidly. But later the expectation of depreciation after the Asian Financial crisis in 1997 prevented the foreign reserves from growing fast. After 2000, the share of foreign assets in total assets of the PBC maintained a rapid growth, which was closely associated with the large rise in China’s current account surpluses. According to OECD statistics, from 2006 on China exceeded Japan as the country with the largest current account surpluses in the world. By the end of 2010, 83.1 per cent of the PBC’s total assets were comprised of foreign assets, that is 21542.0 billion US dollars. Figure 3.5 also shows that the nominal growth rate of the foreign assets held by the PBC has fluctuated wildly, with a value over 100 per cent in 1990 and 1994, and has been around 30 per cent annually since 2001.

The PBC’s large-scale intervention in the foreign exchange market induces two immediate effects. First, the continuous purchase of foreign assets substantially enlarges the size of the PBC’s balance sheet. Table 3.8 reports total central bank assets for four countries between 2002 and 2010: China, Japan, the UK and the US. It can be seen that the assets of the PBC overtook those of the US Federal Reserve in 2004, and have been the largest since 2006. The fast expansions of the balance sheets in all those countries since 2008 were closely related to the quantitative easing policies (QE) aiming at dragging the economy out of recessions. Despite the expansionary effects of QE on the central bank balance sheets of those developed countries, by the end of 2010, the amount of total assets held by the PBC was roughly the sum of those in Japan and the US, and was ten times those of the Bank of England. At the end of the first quarter in 2011, the amount of the PBC’s total assets had exceeded 4 trillion US dollars (4105.03 billion \$US). The dramatically expanding central bank balance sheet in a developing country like China would inevitably raise growing concerns about the health of its central bank, for example, the potential losses of wealth to swings in currency values.

The second consequence of the PBC’s foreign exchange market intervention is the passive increase in money supply. Sales of the renminbi by the PBC in the foreign exchange market are equivalent to injections of a substantial amount of monetary base into the economy, and therefore impose considerable pressure on the money supply and the price level. Figure 3.6 plots the nominal growth rate of the monetary base, and the ratio of the monetary base to nominal GDP. The major spikes of the annual growth rate in 1988, 1990, 1993, 2003 and 2007, as well as the troughs in 1998 and 2009, match those of the annual growth of foreign reserves as shown in Figure

	China	Japan	UK	US
2002	617.47	998.97	73.00	734.18
2003	749.11	1133.11	88.41	773.89
2004	950.31	1336.58	109.17	813.50
2005	1265.22	1413.36	119.62	851.62
2006	1612.54	993.03	157.52	875.07
2007	2223.32	945.02	204.59	894.25
2008	2980.38	1187.47	436.72	2241.34
2009	3330.71	1309.52	370.62	2237.50
2010	3829.61	1466.61	381.34	2423.56

Source: the websites of various central banks: the PBC; the Bank of Japan; the Bank of England; and the Federal Reserve.

Table 3.8: Central bank balance sheets: total assets, 2002–2010 (billion US dollars)

Assets		Liabilities	
Foreign assets	21.54 (3.01)	Currency in circulation (reserve money)	4.86 (0.71)
Other assets	4.39 (0.17)	Deposits of financial corporations (reserve money)	13.67 (3.42)
		Bond issue	4.05 (-0.16)
		Other liabilities	3.35 (-0.80)
Total assets	25.93 (3.17)	Total liabilities	25.93 (3.17)

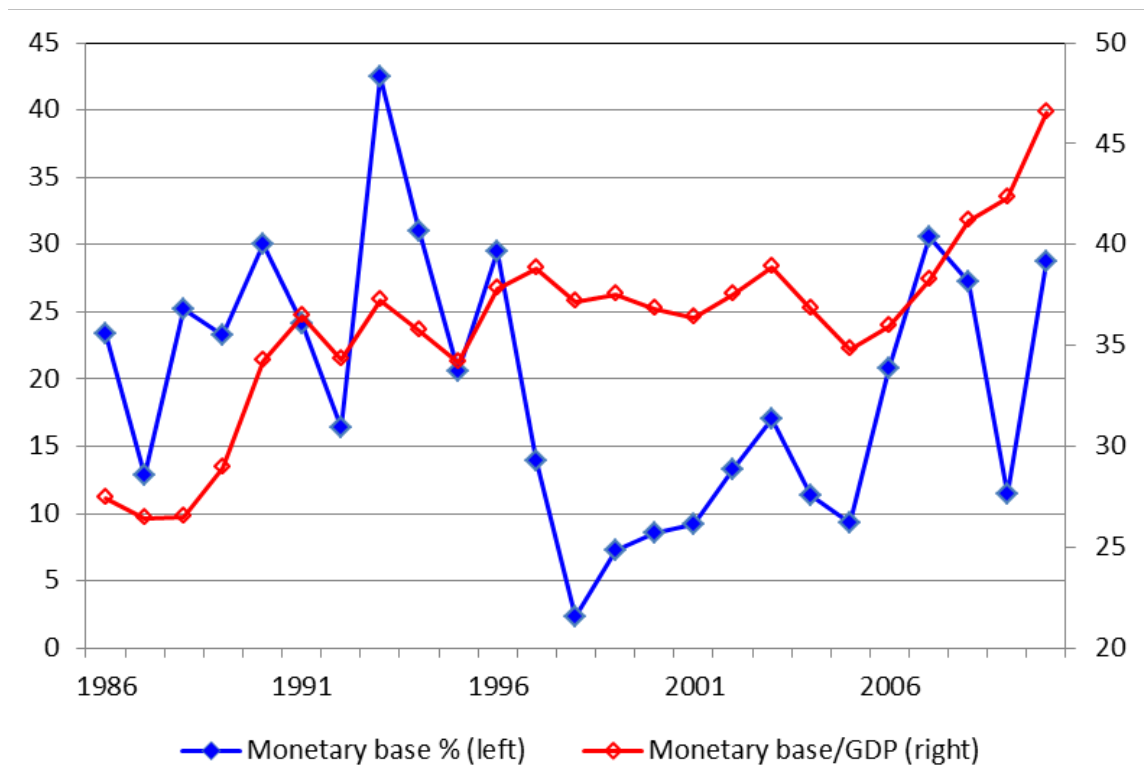
Source: the PBC's website.

Note: the numbers in brackets are changes since the previous year.

Table 3.9: Simplified PBC's balance sheet, 2010 (trillion yuan)

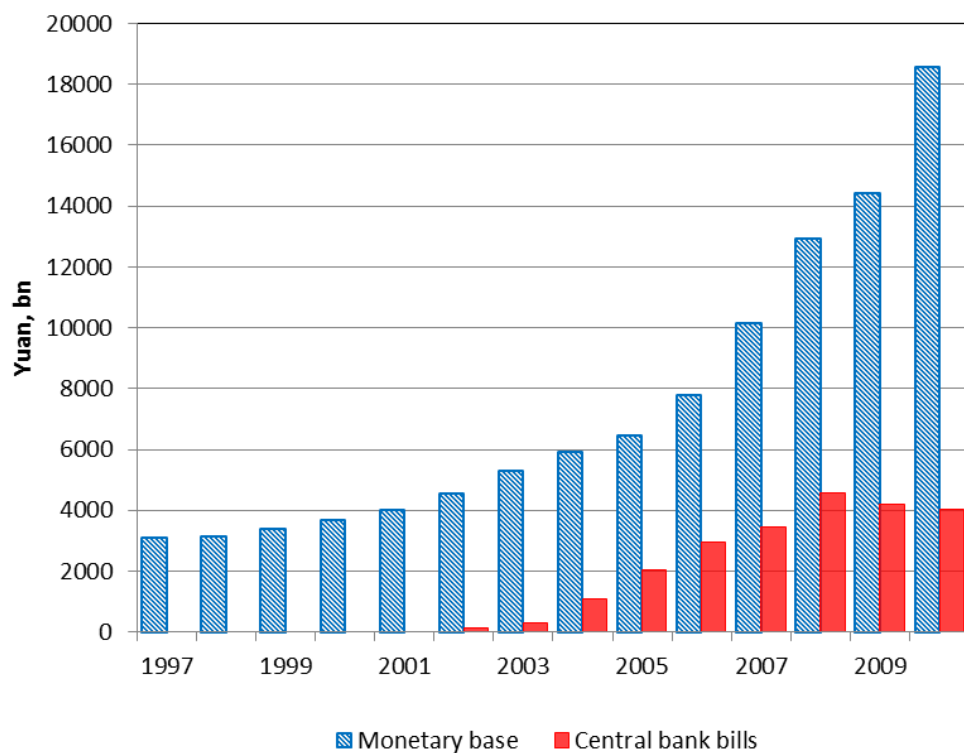
3.5. Thus, the changes in foreign reserves can be regarded as an important factor in affecting the monetary base. Given a sharp decline in 1997 when the Asian Financial Crises broke out, the average growth rate of the nominal stock of monetary base is 19.1 per cent during 1986–2010. Meanwhile, China's monetary base/GDP ratio is 46.6 per cent in 2010, which is almost double that of 1986. Conventionally, such a fast expansion of the monetary base potentially leads to inflationary pressure in the future. During 1986 and 2010, major CPI inflation hikes took place in 1988–89, 1994, 2004 and 2008, closely following the monetary base surges, with a lag of around one year. The large and growing monetary base due to foreign exchange interventions tends to weaken the PBC's ability to control domestic money supply and inflation.

It is noteworthy that Figure 3.7 only reflects the evolution of the monetary base after the PBC's sterilization operations. Typically, the PBC has two instruments



Source: IFS, the PBC's website.

Figure 3.6: Monetary base in China: 1986–2010



Source: IFS, the PBC's website.

Figure 3.7: Monetary base and central bank bills: 1997–2010

to mop up liquidity in the money market: changing the reserve requirement ratio (RRR), and issuing central bank bills. But only the latter has influence on the monetary base. Table 3.9 shows a simplified central bank balance sheet of the PBC in 2010. When there is a purchase of foreign exchange, the PBC could raise the RRR which forces commercial banks and other financial institutions to increase their deposit with the PBC. This operation partly offsets the upward pressure of foreign exchange intervention on currency in circulation. However, on the PBC's balance sheet, the underlying RRR rise only changes the composition of the monetary base, leaving the sum of currency in circulation and deposits of financial corporations unchanged. On the other hand, when the PBC requires banks to buy the special bills it issues to manage liquidity in the banking system, either the excess reserves of the banks with the PBC or liquidities in the interbank market must fall. These so-called central bank bills began to act as an effective instrument in sterilizing as from 2003. Table 3.9 presents the amount of outstanding monetary base and central bank bills during 1997 and 2010. In 2010 the amount of outstanding central bank bills was 4.05 trillion yuan, accounting for 15.6 per cent of the PBC's total liabilities. Thus, if we ignore the liquidity that has been sterilized by the central bank bills, we may underestimate the impact of the PBC's intervention in the foreign exchange market on domestic liquidity.

3.3.5 Fiscal Implications for Monetary Policy in China

According to the theory of fiscal dominance, unsustainable fiscal policy can impede the monetary authority from achieving its policy goal, by replacing the money supply as a determinant of the price level. Therefore, a fiscal dominance regime is often regarded as an important challenge to the effectiveness of monetary policy: it would be more difficult for the monetary authority to keep control over inflation under such a fiscal dominance regime. Before carrying out empirical analyses to look for evidence of fiscal dominance, we examine the possible implications of China's fiscal features for the PBC's monetary policy.

In China's Central Bank Law, the final policy goal of the PBC is to stabilise the value of the currency and stimulate economic growth. To achieve such targets, the PBC adopts the growth rate of a monetary aggregate as an intermediate target, and uses the broad money supply as an influential variable in conducting monetary policy. As we have mentioned earlier, the government enhanced the fiscal discipline after the introduction of the Budget Law in 1994 and the Central Bank Law in 1995. The role of the PBC in financing budget deficits seems to disappear, as the claims of the PBC on the central government stopped increasing and remained relatively stable since 1997.³⁶

³⁶There was only one large change which occurred in 2007 when this item jumped to 1,631.8

However, it seems that the PBC still acts as an executive branch of the government after 1995. According to the Central Bank Law, the PBC is under the leadership of the State Council in conducting the monetary policy.³⁷ As head of the government administration, the State Council has to consider the state of the national economy as a whole rather than considering the PBC and its monetary policy only. Therefore, given the preference of the State Council for rapid economic growth, the PBC is ‘a part of the executive branch of the Chinese government and does not have the independent authority exercised by the Federal Reserve Bank of the United States’.³⁸ Geiger (2006) also points out that there are strong influences from other administrative authorities in the government. As a result, monetary policy is subject to various constraints, which inevitably dampen its independence to some extent. One example is China’s exchange rate regime: if the PBC is totally independent, why would not it make use of a flexible exchange rate when fighting inflation?

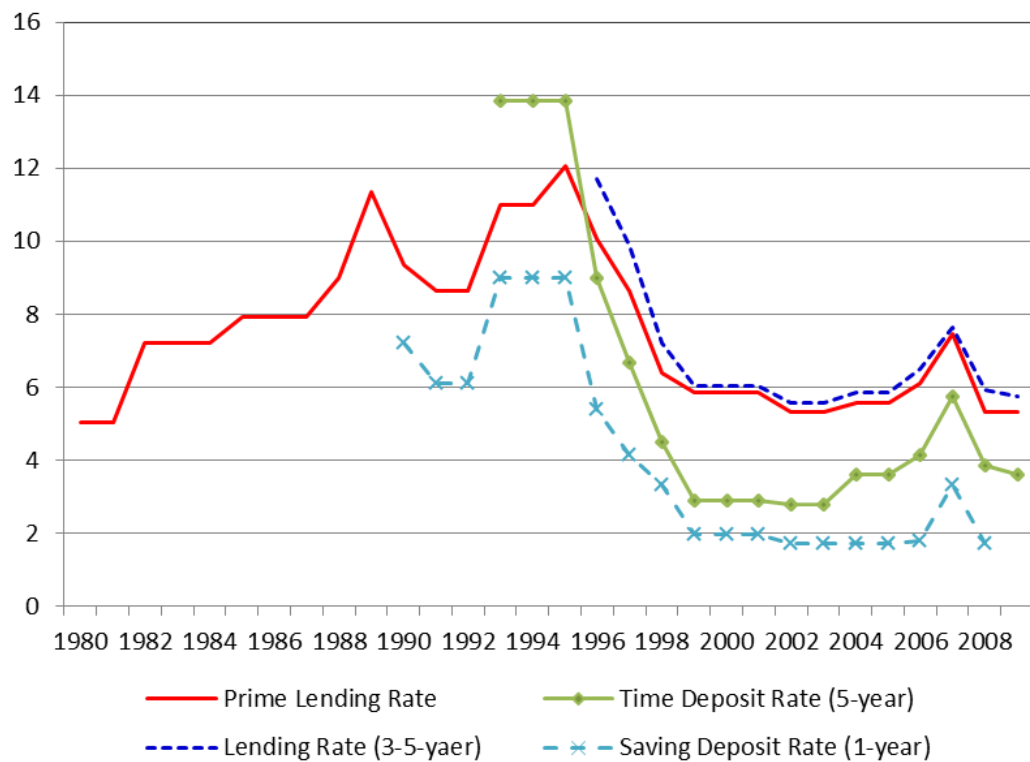
In practice, the manoeuvre of the Central Bank Law makes the issue of PBC’s independence less prominent. First, there is surprisingly no mention of price stability or inflation in the Central Bank Law; instead, maintaining the value of the currency is the priority policy target, as the PBC may regard it as the precondition for economic growth.³⁹ Although it is not clear whether the PBC is to maintain the internal or external value of the currency, it seems that in practice the exchange rate is its target, while inflation is not. Consequently, the efforts of the PBC to maintain a managed exchange rate by accumulating massive foreign exchange reserves regardless of inflation justifies its ‘independence’ in conducting policy. Inflationary pressure is regarded as the by-product, which requires additional sterilization by the PBC’s open market operations. So it is nearly impossible for the PBC to curb inflation by intentionally adjusting the exchange rate. Secondly, the State Council takes macroeconomic planning and management as its main responsibility. From the State Council’s perspective, since monetary policy is closely associated with its responsibility, then the PBC should be placed under its control. In doing so, the State Council can coordinate the fiscal and monetary policies at the same time. Chow (2002, p. 226) points out that any factors, which may harm the political stability of China, would be taken seriously; monetary policy is, of course, one of those factors. So he claims that since this institutional arrangement has settled in China, it appears to be difficult to make any changes in the foreseeable future.

billion yuan from 285.6 billion yuan a year earlier. In fact, such a huge change was not associated with fiscal deficits, but with the government’s intention to improve its foreign exchange reserves. In 2007, in order to improve foreign exchange reserves management, the Ministry of Finance issued the Special Treasury Bonds in exchange for \$200 billion foreign exchange reserves held by the PBC. The MOF then invested the money into China Investment Corp (CIC).

³⁷See China’s Central Bank Law, Chapter 1, Article 2.

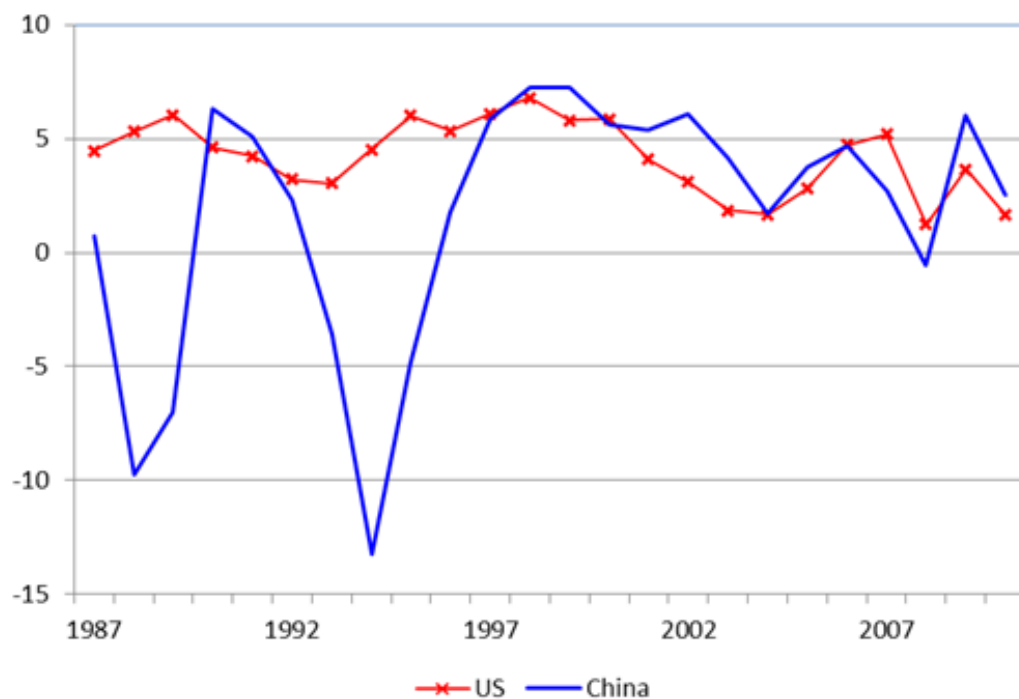
³⁸See Chow, 2002, p. 221.

³⁹See the Central Bank Law, Article 3: “The aim of monetary policies shall be to maintain the stability of the value of the currency and thereby promote economic growth.”



Source: IFS, DataStream.

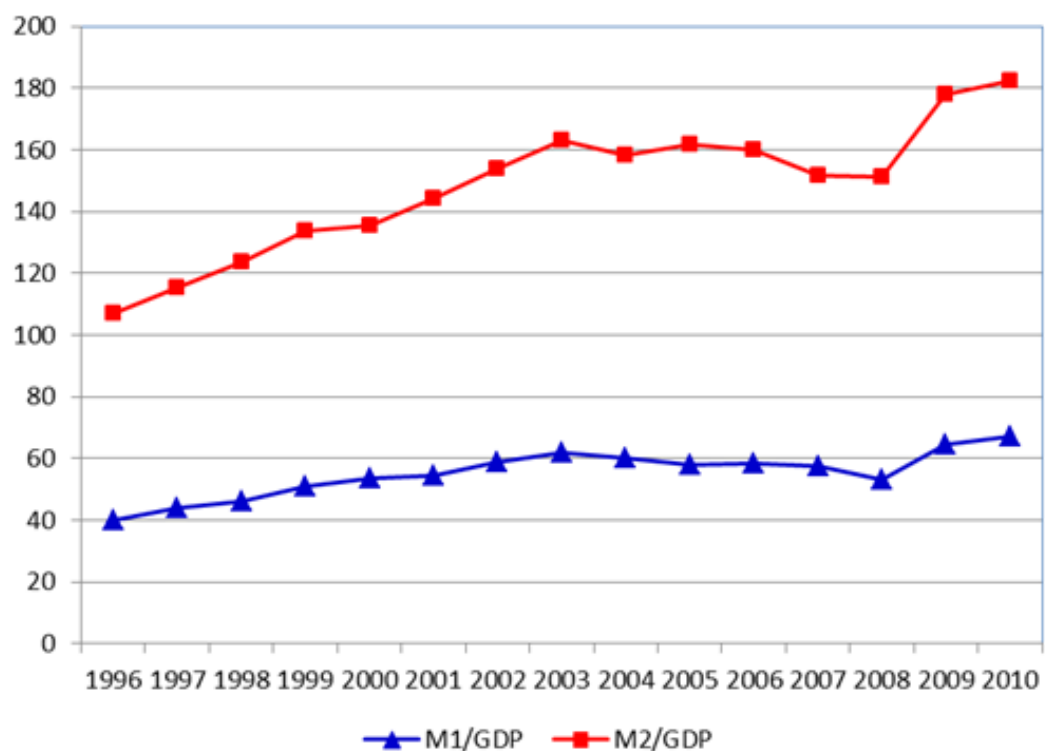
Figure 3.8: Nominal Interest Rates in China



Note: The real interest rates are calculated as the prime lending rate deflated by CPI inflation of the current year.

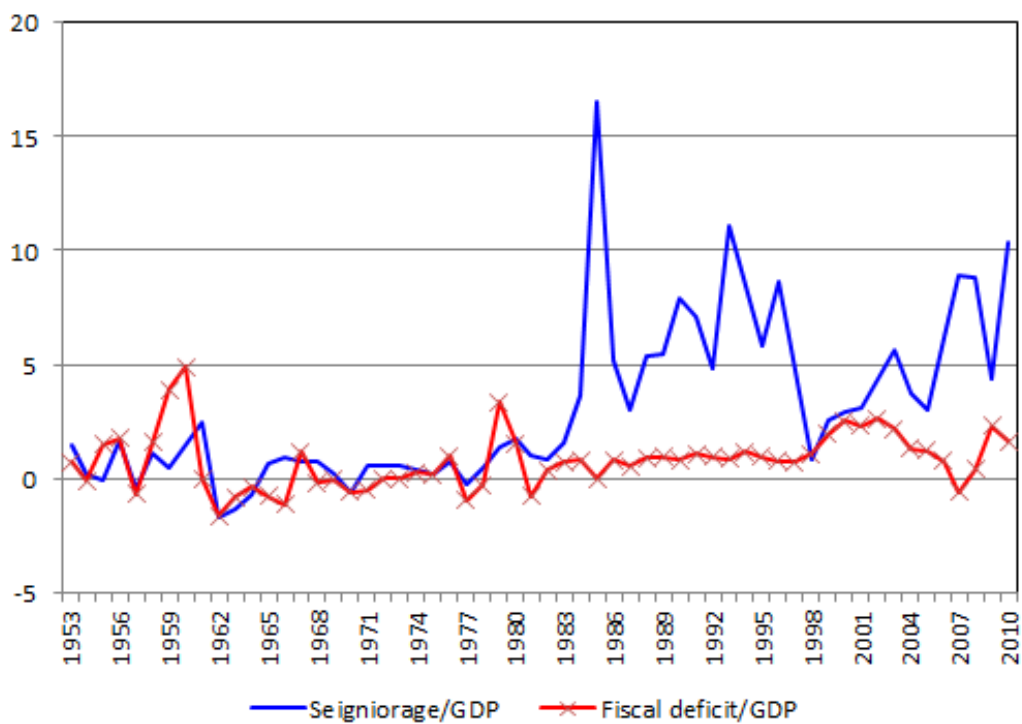
Source: Author's calculation; IFS.

Figure 3.9: Real Interest Rate: China and US



Source: Author's calculation; IFS.

Figure 3.10: China's M1 and M2 as Percentage of GDP



Source: Author's calculation; IFS.

Figure 3.11: Seigniorage and Fiscal Deficits as Percentage of GDP

The constraints from the fiscal perspective on the monetary policy can also be observed in other aspects. Currently, the PBC still needs the approval of the State Council when it determines the money supply, interest rates and the exchange rate. Figure 3.8 presents four major interest rates in China. Although some of the controls were removed after reforms, by 2006 there were still 29 key interest rates under strict controls of the state.⁴⁰ Between 1980 and 2010, the average real GDP growth rate was 10.0 per cent, but the average nominal prime lending rate was only 7.5 per cent. When deflated by CPI inflation, the average real primary lending rate is 1.7 per cent. In particular, real rates were negative in eight out of thirty years. With interest rates at such artificially low levels, the banks provide massive cheap money to domestic economic development, including financing the SOEs and state projects. Meanwhile, the differentials between the primary lending rate and the 3-to-5-year lending rate are tiny, which encouraged the allocation of resources towards long-term, government-oriented construction projects. In addition, as we have discussed earlier, the problem of the considerable amount of NPLs in the banking system is a serious concern for interest rate policies. So in order to maintain financial stability, the PBC is conservative in adjusting interest rates. Therefore, only a few changes in interest rates can be observed over the past decades. Given the low prime lending rate, there are even lower deposit rates. As a result, there has been a substantial differential between the prime lending and deposit rates, which could be considered as a subsidy for banks and a tax levied on deposits. In addition, Figure 3.9 shows the real interest rate movements in China and the US between 1987 and 2009. It can be seen that before 1993, the difference between the two interest rates was considerable; but after 1994 it decreased significantly. The graphs partly reflect the PBC's efforts to maintain the value of China's currency. Under a pegged exchange rate, a low interest rate spread is helpful because it reduces the pressure from capital inflows. More issues related to the currency peg will be discussed in Section 3.5.

As rapid growth of money supply is often associated with high inflation, Figure 3.10 shows M1 and M2 as a percentage of GDP over 1996–2010. Taking M2 as an example, the ratio increases significantly from 106.9 per cent in 1996 to 182.4 per cent in 2010. The increase in the M2/GDP ratio, however, reflects a falling income velocity of circulation.⁴¹ If the government monetizes some of its fiscal deficits, it would then generate direct inflationary pressures. We use a conventional way to define China's seigniorage, which is the increment of the monetary base over a year, regardless of the costs arising in the money creation process. Figure 3.11 plots the seigniorage as a percentage of GDP since 1952. In order to see its relation with the fiscal policy stance, we also plot government balances against GDP in the same graph.

⁴⁰See Liew and Wu, 2007, p. 133.

⁴¹See Burdekin, 2008, p. 62.

Over 1980–2010, the PBC has generated substantial amount of seigniorage revenue except for the period of the Asian Financial Crises in 1997. As Figure 3.11 shows, a large fiscal deficit is usually accompanied by a sharp increase in seigniorage revenue, for example, around the year 1955, 1960, 1980, 1983, 2001, and 2010. This positive relationship between seigniorage revenue and fiscal deficits is consistent with a fiscal dominance regime. In addition, all large increases in seigniorage revenue in 1960, 1980, 1984, 1988, 1992, 2003, and 2006 can be associated with inflation peaks in the same year, respectively.

Keep in mind that China’s pegged exchange rate regime also has a significant impact on the money supply. With the PBC’s policy target of a stable exchange rate, it has to buy all excess foreign exchange in the market to stabilize the value of renminbi. Such interventions lead to a substantial increase of the foreign exchange component in the monetary base. In 1995 following the exchange rate reform, the ratio of foreign exchange to monetary base was 31.4 per cent; by 2009, it had jumped to 121.6 per cent as a result of a vast accumulation of foreign exchange reserves. The figures may imply that the PBC is under strong external pressure to control the money supply. In addition, it is difficult to see intuitively whether the increase in the monetary base should be attributed to the currency peg, or should be regarded as evidence of the monetisation of fiscal deficits by the PBC. Further examination will be carried out in Section 3.5.

3.3.6 Two Cases of Fiscal Dominance: Brazil and Turkey

In order to clarify the impact of fiscal issues on monetary policy in practice, we briefly examine two case studies: Brazil and Turkey.⁴² The case in Brazil around 2002 illustrates the importance of public debt. In the 1990s, Brazil faced high fiscal deficits, inflation and dramatic policy shifts. From 1999, both the public debt to GDP ratio and the dollar denominated debt increased rapidly. Because of public concerns about the potential default risk on public debt, a higher real interest rate could trigger a capital outflow and generate a ‘perverse’ effect on the exchange rate, i.e. a depreciation of the currency. Thus, a tightening of monetary policy aimed at pinning down inflation would be weakened by a real depreciation caused by the monetary tightening itself. Given this background, the central bank’s choice of not increasing the real interest rate in response to the inflation from mid-2002 to 2003 is widely considered correct. According to the estimate by Blanchard (2004), the net effect of an increase in the interest rate of 100 basis points is equivalent to a depreciation of 258 basis points.

The case of Turkey is characterized by an enhanced fiscal discipline and an

⁴²Turkey’s case is summarized from Sturm and Gurtner (2007) and Ersel and Özatay (2008); Brazil’s case is summarized from Blanchard (2004) and Tanner and Ramos (2002).

increasingly independent central bank. Prior to 2000, Turkey had experienced a 40 per cent inflation rate for more than four decades; it had also accumulated public debt of 58 per cent of its GDP. This high and persistent inflation was believed to be the result of a lax fiscal policy, as the central bank partially monetized the fiscal deficits. The situation under the fiscal dominance regime further worsened after a financial crisis in Turkey in 2001. Inflation rose sharply to 51 per cent, and public debt rocketed up to 105.1 per cent of GDP in the third quarter of 2001. The surge in public debt was mainly due to three factors. First, the devaluation of the Turkish lira increased the value of external debt and foreign currency denominated domestic liabilities. Second, the restructuring of the banking system turned the government's contingent liabilities into public debt. Third, the interest rates and bond spreads were raised in the economy slowdown, and people were more concerned about the sustainability of the public debt. However, in 2001 reforms took place in both fiscal and monetary system. The Central Bank of Turkey (CBT) obtained more independence after the adoption of a new central bank act. In addition, it implemented an implicit inflation target. In the public sector, transparency, budget discipline and accountability were greatly enhanced. As required by the IMF, the government set a specific goal for its primary surpluses each year. By the end of 2006, the public debt to GDP ratio had decreased to 59.9 per cent, with inflation falling to 9.7 per cent, due to the success of the reforms. More importantly, Turkey maintained strong economic growth during the disinflationary process, with a 7.3 per cent growth rate on average over 2002–06.

If we return to the case of China, some similar features may be found compared with Brazil and Turkey. Firstly, there has been an increasing public debt in the past decades, and persistent fiscal deficits have become a remarkable feature. Secondly, the government has been under inflationary pressure during most of the post-reform period since 1978, except for only a few years because of the two financial crises around 1997 and 2008. Thirdly, there is a lack of commitment by the fiscal authority to targets for the primary surplus, and the PBC is constrained to conduct monetary policy independently. All these similarities raise concerns about any potential fiscal dominance the PBC may suffer.

More importantly, there are some valuable lessons from Brazil and Turkey for fiscal and monetary policies in China. Firstly, sound fiscal discipline is a precondition for sustainable economic growth. Secondly, high public debt plays a crucial role in forming inflation expectations, as the default risk may cause a tightening of monetary policy to generate a perverse effect on the real exchange rate. Third, given that certain conditions are met, the combination of inflation targeting and explicit fiscal anchors seems to be an effective way to overcome inflation. In Turkey's case, it worked particularly well when Turkey was confronted with high public debt and a severe inflation problem.

3.4 The Empirical Evidence of an FD Regime

In this section we develop some tests for the existence of FD in the case of China. As we have discussed, the concept of an FD regime refers to the circumstances in which monetary policy is influenced by fiscal policy. However, it may be not easy to implement such a test. As a first step to distinguish between FD and MD regimes, we follow Canzoneri et al. (2001b) and implement a VAR method, involving the primary surplus and government liabilities. Then we examine the impulse response functions of the VAR model. We can distinguish between FD and MD regimes by looking at how the shocks to the current primary surplus affect future real liabilities. This VAR method mentioned above has several advantages. First, it looks at the dynamic relationship between the primary surplus and real liabilities, so we only estimate a small number of parameters. Second, it does not impose any structure on the economy. The variables in the VAR model are treated as a priori endogenous, not predetermined by structural equations.

In the next part of this section, we first introduce the framework of the government's intertemporal budget constraint which links fiscal and monetary policies. We discuss the characteristics of the FD and MD regimes. In particular, we consider the context of an FD regime in which a certain amount of seigniorage must be delivered in order to balance the fiscal budget. Then we use a VAR to examine how liabilities and the future surplus respond to the shocks in the primary surplus, and we investigate whether MD or FD provides a more plausible explanation of the impulse responses for the Chinese data.

3.4.1 *The framework of government's intertemporal budget constraint*

Conventionally, the literature on FD links fiscal policy and monetary policy through the government's budget constraint. It helps us to understand the implications of seigniorage for the government's revenue needs, as well as the implications of the primary surplus for government liabilities. To this end, we begin the empirical analysis with the government's intertemporal budget constraint. Consider a consolidated government budget identity, which includes the role of the central bank, in the following form:

$$B_{t-1} = T_t - G_t + \frac{B_t}{1+i_t} + (M_t - M_{t-1}) \quad (3.1)$$

where B_t denotes outstanding debt; T_t denotes tax revenue; G_t denotes government expenditure; i_t denotes nominal interest rate; and M_t denotes the monetary base or the liabilities of the central bank. Equation (3.1) implies that the government debt must be funded by the primary surplus $T_t - G_t$, plus new issues of liabilities by the consolidated government sector $\frac{B_t}{1+i_t} + (M_t - M_{t-1})$. Note that $(M_t - M_{t-1})$ is the

change in the central bank's own liabilities. Rearrange equation (3.1), we obtain the following expression for the consolidated government sector's total liabilities:

$$M_{t-1} + B_{t-1} = T_t - G_t + \frac{B_t}{1 + i_t} + M_t \quad (3.2)$$

According to equation (3.2), there are three sources to pay off the existing debt: the primary surplus, the seigniorage revenue, and issues of new debt. To facilitate the discussion in real terms, we scale all the terms by the nominal output, denoted by $p_t y_t$, where p_t is the price level and y_t is the real output. After some rearrangements the budget constraint can be written as

$$\frac{M_{t-1} + B_{t-1}}{p_t y_t} = \left[\frac{T_t - G_t}{p_t y_t} + \frac{M_t}{p_t y_t} \frac{i_t}{(1 + i_t)} \right] + \frac{1}{(1 + i_t)} \frac{M_t + B_t}{p_t y_t} \quad (3.3)$$

Note that the last term on the RHS in equation (3.3) can be first multiplied and then divided by $p_{t+1} y_{t+1}$, yielding

$$\frac{M_{t-1} + B_{t-1}}{p_t y_t} = \left[\frac{T_t - G_t}{p_t y_t} + \frac{M_t}{p_t y_t} \frac{i_t}{(1 + i_t)} \right] + \frac{(y_{t+1}/y_t)}{(1 + i_t)(p_t/p_{t+1})} \left(\frac{M_t + B_t}{p_{t+1} y_{t+1}} \right) \quad (3.4)$$

Equation (3.4) says that the ratio of total government liabilities to GDP at the beginning of the period t equals the sum of the primary surplus and seigniorage to GDP ratio, plus the discounted value of next period's total government liabilities. The discount factor, $\frac{(y_{t+1}/y_t)}{(1 + i_t)(p_t/p_{t+1})}$, is the ratio of real output growth to the real interest rate. If we write the total liabilities to GDP as $w_t = \frac{M_{t-1} + B_{t-1}}{p_t y_t}$, the primary surplus to GDP as $s_t = \frac{T_t - G_t}{p_t y_t}$, seigniorage to GDP as $\theta_t = \frac{M_t}{p_t y_t} \frac{i_t}{(1 + i_t)}$ and discount factor as $\alpha_t = \frac{(y_{t+1}/y_t)}{(1 + i_t)(p_t/p_{t+1})}$, equation (3.4) can be rewritten as

$$w_t = s_t + \theta_t + \alpha_t w_{t+1} \quad (3.5)$$

We then iterate equation (3.5) forward, and take the expectations conditional on period t

$$w_t = s_t^* + E_t \left[\sum_{j=t+1}^{+\infty} \left(\prod_{k=t}^{j-1} \alpha_k \right) s_j^* \right] \quad (3.6)$$

For a consolidated government sector, the total primary surplus should be the sum of s_t and θ_t . In their paper Canzoneri et al. (2001b) mark this total primary surplus as s_t . In order to avoid any confusion, we denote the primary surplus of the consolidated government sector as s_t^* in the following analyses, where $s_t^* = s_t + \theta_t$. Equation (3.6) provides several key implications for the ways in which the government's intertemporal budget can be balanced. First, the sequence $\{s_t^*\}$ may move endogenously to satisfy equation (3.6). Canzoneri et al. (2001b) define an MD regime in this way that $\{s_t^*\}$ is responsible for balancing the intertemporal government budget constraint. Second, within the sequence $\{s_t^*\}$, only $\{s_t\}$ is exogenously determined by the fiscal

authority; however, the sequence $\{\theta_t\}$ adjusts to make sure $\{s_t^*\}$ is unchanged. Third, although the nominal total government liabilities $M_{t-1} + B_{t-1}$ are predetermined at the end of period $t - 1$, their real value w_t depends on real output y_t and the price level p_t . So even when $\{s_t\}$ and $\{\theta_t\}$ are both exogenously determined, y_t or p_t can jump to balance equation (3.6). The second and third possibilities are regarded as an FD regime. The last possibility is commonly referred to as the fiscal theory of price level (FTPL), in the mechanism of which p_t is picked out by $\{s_t\}$. So the price level is independent of the nominal money supply.

With the implications discussed above, we can adopt some strategies to identify an MD regime from an FD one. In an MD regime, an increase in s_t^* would be used to pay off some of the debt, so w_t will fall. In equation (3.6), suppose that the current increase in s_t^* will not lower future s_t^* , then a positive shock to s_t^* will reduce future w_t . As Canzoneri et al. (2001b) indicate, this assumption about the nonnegative serial correlation of s_t^* is essential, for without it the result will become inconclusive. If a positive shock to s_t^* were associated with a reduction in future s_t^* , it would generate a reduction in w_t in the case of either an FD or an MD regime.

Consider next that in an FD regime, s_t^* is arbitrarily determined by the government, so it is the fiscal theory of price level (FTPL) that is responsible for balancing equation (3.6). If that is the case, future real liabilities would not be affected by the shock to the primary surplus s_t^* . If the primary surplus is positively serially correlated, future real liabilities should rise to balance the government budget. We follow the methods proposed by Canzoneri et al. in a VAR framework to distinguish between FD and MD regimes, and the criteria discussed above are summarized in Table 3.10:

If the serial correlation of s_t^* is	If the response of w_t is		
	Positive	Insignificant	Negative
Positive	<i>FD</i>	<i>FD</i>	<i>MD</i>
Insignificant	<i>FD</i>	<i>FD</i>	<i>MD</i>
Negative	<i>FD</i>	<i>FD</i>	<i>Interminate</i>

Source: Canzoneri et al. (2001b).

Table 3.10: Differentiating between FD and MD regimes given a positive shock to the primary surplus

It may be argued, however, that this test is subject to some limitations. First, the model does not incorporate the responses of the primary surplus to the business cycle. According to the automatic stabilizer theory, the fiscal surplus tends to respond to output fluctuations; it decreases as the economy enters recession and increases when the economy booms. If the government were unable to generate larger primary balances, or is unwilling to do so during the period of recessions, there would be a

lack of a significant relationship between primary surplus and total liabilities even in an MD regime. Thus, Zoli (2005) argues that if the sample period is too short and only reflects a unique phase of the cycle, the difference between FD and MD becomes blurred. However, the period we want to examine in China covers the period from 1980 to 2010, which may make this limitation less serious. A second limitation of this method is pointed out by Buiter (1999) and Cochrane (1998) who argue that equation (3.6) only holds for the equilibrium price. If the non-equilibrium price level cannot be observed, then the implications of the two regimes would give ambiguous results. Given these limitations, the test discussed above should be regarded as an early analysis of the interaction between China's fiscal and monetary policies. In particular, it is a good starting point for examining China's fiscal regime in order to shed some light on how the performance of monetary policy could be improved.

3.4.2 *Variables and data*

The approach used in the VAR model contains only two variables: the primary surplus, and the total liabilities. Some issues, according to the model specification, should be kept in mind. First, the primary surplus of the consolidated government sector includes the seigniorage revenue which is calculated by $M_t i_t / (1 + i_t)$. Second, outstanding reserve money (or the monetary base, or the high-powered money) is regarded as the liabilities of the consolidated government sector. Finally, for the period t , the total liabilities are the sum of the outstanding Treasury bonds and the outstanding monetary base at the end of period $t - 1$ (recall that $w_t = (M_{t-1} + B_{t-1}) / p_t y_t$). We scale both of the variables by the nominal GDP of the same period, which is a conventional method in studies of fiscal policy. We collect the data from China Economic Information Network (CEIN), the DataStream database, China's National Bureau of Statistics, and from the website of the PBC. The sample period runs from 1980 to 2010, due to the fact that China did not issue government bonds before 1980. In Table 3.11, we present summary descriptions of the variables and data sources.

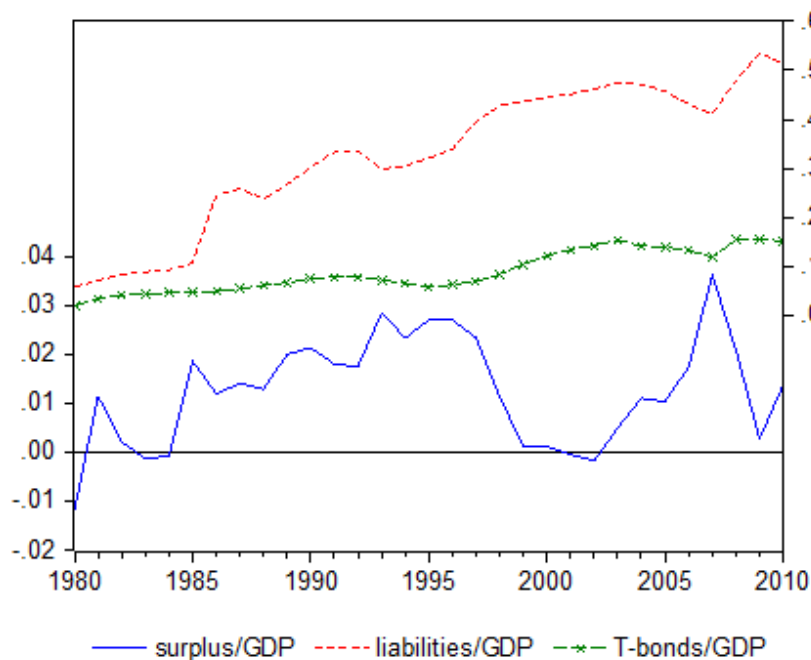
Note that there are some data issues related to China's unique institutional and economic conditions. First, before 1995 the Ministry of Finance (MOF) could borrow directly from the PBC to finance its budget. So the liabilities of the government consisted of the Treasury Bonds and direct borrowing from the PBC. In the model, however, the government and the PBC are considered as a group. So the money borrowed and lent within the consolidated sector is not included in the total liabilities. Second, the external debt the government borrows abroad accounts for fairly a small proportion of the total debt borrowed by the government. For example, during 2005 and 2009 the average proportion was about 1.4 per cent. So the role of external debt borrowed by the government is not a concern in the following analyses.

Variable	Definition	Source
s_t^*	(1) Government revenue minus (2) government expenditure, plus (3) interest payments on government debt*, plus (4) seignorage revenue**, scaled by (5) nominal GDP.	(1) - (3): China Economic Information Network (CEIN) (4): Author's calculation (5): DataStream (6): National Bureau of Statistics, China
w_t	(6) Outstanding Treasury bonds at the end of period $t - 1$, plus (7) monetary base at the end of period $t - 1$, scaled by (5) nominal GDP of period t .	(7): DataStream; the website of the People's Bank of China.

* Interest payments on government debt are not included in the government expenditure before 2000.

** Seignorage revenue (4) is calculated as follows $M_t i_t / (1 + i_t)$, where i_t the nominal primary lending rate, M_t is the nominal stock of monetary base at the end of period t . The data is from DataStream and the website of the People's Bank of China.

Table 3.11: Definition and data sources of variables



Notes: The scale for primary surplus/GDP, S , is on the left; that for total liabilities/GDP and T-bonds/GDP is on the right.

Figure 3.12: Surplus/GDP, liabilities/GDP and outstanding T-bonds/GDP: 1980–2010

In Figure 3.12, we plot s_t^* and w_t over 1980–2010. For comparison purposes, we also present the series of the treasury bonds (T-bonds) to GDP ratio. Note that the difference between w_t and T-bonds/GDP reflects the evolution of the monetary base (includes the direct borrowing by the MOF before 1995). At a first glance, s_t^* and w_t have a positive correlation before 1995, with a correlation of 0.78; after 1995, the correlation becomes negative, at -0.53 . The positive correlation over 1980–94 exhibits a clear feature of the fiscal dominance; however, the implication of a negative correlation over 1995–2010 may be somewhat complicated, which depends on the direction of causation between s_t^* and w_t , the liabilities would be responding negatively to the primary surplus. The surplus pays off some of the debt, which suggests the MD regime. If, however, the causation goes the other way, then s_t^* would be responding negatively to w_t . This negative correlation may be seen as evidence of the FD regime, as it suggests there is no fiscal policy rule that could force the primary surplus to respond positively to the amount of total liabilities. Therefore, the correlation between s_t^* and w_t in Figure 3.12 provides an ambiguous signal to identify the regime for China’s data. The autocorrelations of s_t^* suggest that there is significant positive autocorrelation at lags up to four years. According to the criteria in Table 3.10, there would be a monetary dominance regime if the response of w_t is negative. Thus, further empirical evidence from a VAR model is needed to distinguish those two regimes.

3.4.3 Empirical issues and implications

The VAR model we estimate can be expressed as follow:

$$\begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix} \begin{bmatrix} s_t^* \\ w_t \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} s_{t-1}^* \\ w_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_{s_t^*} \\ \epsilon_{w_t} \end{bmatrix} \quad (3.7)$$

where b and γ are coefficients, ϵ is a white noise shock. The structure of the system allows s_t^* and w_t to have contemporaneous effects on each other. We choose one lag in the model, based on the Schwarz Information Criterion (SC) statistic. For simplicity, we denote

$$\mathbf{B} = \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix} \quad (3.8)$$

The structural VAR (3.7) can be transformed into a standard VAR model by pre-multiplying \mathbf{B}^{-1} on both sides of (3.7):

$$\begin{bmatrix} s_t^* \\ w_t \end{bmatrix} = \begin{bmatrix} \frac{b_{10} - b_{12}b_{20}}{1 - b_{12}b_{21}} \\ \frac{b_{20} - b_{10}b_{21}}{1 - b_{12}b_{21}} \end{bmatrix} + \begin{bmatrix} \frac{\gamma_{11} - b_{12}\gamma_{21}}{1 - b_{12}b_{21}} & \frac{\gamma_{12} - b_{12}\gamma_{22}}{1 - b_{12}b_{21}} \\ \frac{\gamma_{21} - \gamma_{11}b_{21}}{1 - b_{12}b_{21}} & \frac{\gamma_{22} - \gamma_{12}b_{21}}{1 - b_{12}b_{21}} \end{bmatrix} \begin{bmatrix} s_{t-1}^* \\ w_{t-1} \end{bmatrix} + \begin{bmatrix} \frac{\epsilon_{s_t^*} - b_{12}\epsilon_{w_t}}{1 - b_{12}b_{21}} \\ \frac{-b_{21}\epsilon_{s_t^*} + \epsilon_{w_t}}{1 - b_{12}b_{21}} \end{bmatrix} \quad (3.9)$$

Or simply:

$$\begin{bmatrix} s_t^* \\ w_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} s_{t-1}^* \\ w_{t-1} \end{bmatrix} + \begin{bmatrix} e_{s_t^*} \\ e_{w_t} \end{bmatrix} \quad (3.10)$$

The error terms in the standard VAR model can be expressed as linear combinations of independently distributed shocks to s_t^* and w_t

$$\begin{bmatrix} e_{s_t^*} \\ e_{w_t} \end{bmatrix} = \frac{1}{1 - b_{12}b_{21}} \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix} \begin{bmatrix} \epsilon_{s_t^*} \\ \epsilon_{w_t} \end{bmatrix} \quad (3.11)$$

If we iterate the standard VAR (3.10) backward, and substitute (3.11) into the model, we can write the model in terms of a vector moving average, so s_t^* and w_t can be expressed in terms of the current and past values of the shocks, $\epsilon_{s_t^*}$ and ϵ_{w_t} :

$$\begin{bmatrix} s_t^* \\ w_t \end{bmatrix} = \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^i \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \frac{1}{(1 - b_{12}b_{21})} \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^i \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix} \begin{bmatrix} \epsilon_{s_{t-i}^*} \\ \epsilon_{w_{t-i}} \end{bmatrix} \quad (3.12)$$

The second term on the RHS of (3.12) can be written as:

$$\frac{1}{(1 - b_{12}b_{21})} \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^i \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix} \begin{bmatrix} \epsilon_{s_{t-i}^*} \\ \epsilon_{w_{t-i}} \end{bmatrix} = \sum_{i=0}^{\infty} \begin{bmatrix} \phi_{11}(i) & \phi_{12}(i) \\ \phi_{21}(i) & \phi_{22}(i) \end{bmatrix} \begin{bmatrix} \epsilon_{s_{t-i}^*} \\ \epsilon_{w_{t-i}} \end{bmatrix} \quad (3.13)$$

Equation (3.13) states that the effect of shocks $\epsilon_{s_{t-i}^*}$ and $\epsilon_{w_{t-i}}$ on s_t^* is determined by the impact multiplier $\phi_{11}(i)$ and $\phi_{12}(i)$, respectively. Similarly, the effect of shocks $\epsilon_{s_{t-i}^*}$ and $\epsilon_{w_{t-i}}$ on w_t is determined by $\phi_{21}(i)$ and $\phi_{22}(i)$, respectively. This approach to tracing out the time paths by which s_t^* and w_t respond to the shocks $\epsilon_{s_t^*}$ and ϵ_{w_t} generates what is known as the impulse response functions (IRFs). However, there is a common identification problem in decomposing residuals into shocks. This problem arises because there are ten coefficients which need to be recovered in the structural model (3.7); but there are only nine coefficients which can be estimated from the standard model (3.10) (including $var(e_{s_t^*})$, $var(e_{w_t})$, and $cov(e_{s_t^*}, e_{w_t})$) using OLS. Therefore, it is impossible to identify the structural model (3.7) unless we impose a restriction on b_{12} or b_{21} in matrix **B**.

To address this identification problem, we adopt the Cholesky decomposition approach, which is conventionally used to orthogonalize the shocks in VAR analyses. As we only have two variables in the VAR model, the situation is easier than that in larger models. Firstly, we assume that $b_{21} = 0$ in equation (3.8). According to

the structural model (3.7) this implies that s_t^* has no contemporaneous effect on w_t ; only the lagged term s_{t-1}^* can affect w_t . Equation (3.11) then becomes

$$e_{s_t^*} = \epsilon_{s_t^*} + b_{12}\epsilon_{w_t} \quad (3.14)$$

$$e_{w_t} = \epsilon_{w_t} \quad (3.15)$$

In fact, this approach to identify the shocks of s_t^* and w_t is in line with the context of an MD regime. Equation (3.15) implies that liabilities/GDP ratio is completely exogenous, or is predetermined at the beginning of period t . Equation (3.14) can be thought of as a fiscal rule, as the current level of liabilities influence the setting of the primary surplus.

Because the responses may change dramatically if the ordering of the variables changes, we then specify a second ordering by imposing the restriction: $b_{12} = 0$. This assumption corresponds to the situation that w_t is contemporaneously affected by s_t^* , and only the shocks $\epsilon_{s_t^*}$ affect the contemporaneous values of s_t^* in the VAR system.

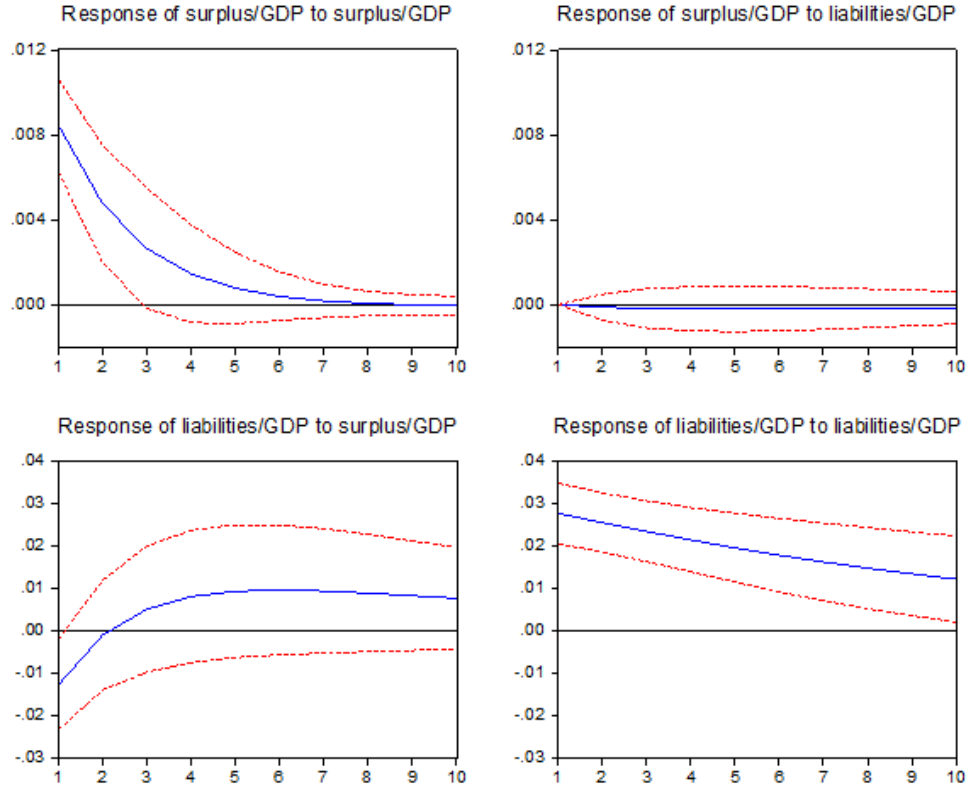
$$e_{s_t^*} = \epsilon_{s_t^*} \quad (3.16)$$

$$e_{w_t} = b_{21}\epsilon_{s_t^*} + \epsilon_{w_t} \quad (3.17)$$

The situation depicted in equation (3.16) and (3.17) makes more sense in an FD regime. In equation (3.16) the primary surplus is an arbitrary process, because the government sector sets its primary surplus arbitrarily without any regard to the intertemporal government budget constraint (3.6). The contemporaneous primary surplus enters into equation (3.17) and affects the total liabilities. The corresponding effects on real liabilities are either through the channel of FTPL (the price level would fall, causing a rise in the real liabilities), or through the generation of the seigniorage revenue (the supply of money would increase, causing a rise in the nominal liabilities).

The rest of this section provides some empirical results from the VAR model. All the analyses we make are based on the estimation and diagnostic tests obtained in *Eviews 6*. The model does not have a root outside the unit circle, and is thus stable. The autocorrelation LM statistics suggest that the hypothesis of no serial correlation in the error terms is accepted. The Granger Causality Tests suggest that s_t^* does Granger Cause w_t , but w_t does not Granger Cause s_t^* . Interestingly, this result is consistent with the existence of a FD regime.

Figure 3.13 plots the impulse response functions of the VAR to a positive surplus/GDP shock. The impulse responses are computed from the ordering of the variables $[s_t^*, w_t]$ where surplus/GDP comes first. Note that this ordering allows for no contemporaneous effects of w_t on s_t^* , and \mathbf{B} is then a lower triangular matrix. The



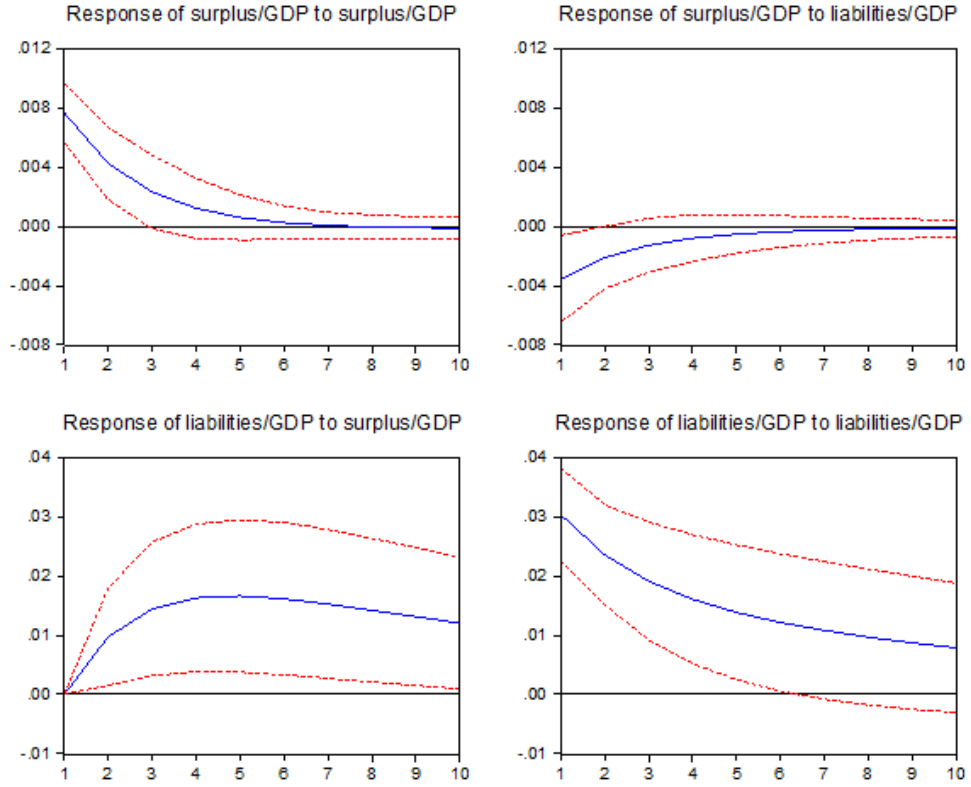
Notes:

1. The VAR is estimated with one lag and a constant over 1980–2010.
2. The standard error bands are based on an asymptotic approach, and are denoted by the red dashed lines.
3. The order of Cholesky decomposition is surplus/GDP, liabilities/GDP.

Figure 3.13: Impulse responses to a positive innovation in primary surplus-to-GDP ratio: order 1

two standard deviation bands are represented by the dashed lines. As we discussed earlier, the focus of the analysis is on the responses to the s_t^* shocks. The responses of w_t are plotted on the bottom left panel of Figure 3.13. In period 1, there is a negative and significant response of w_t to a positive s_t^* shock. This response quickly becomes positive and remains positive but insignificant for the following nine years. Note that the impulse responses of s_t^* to its own shock, shown in the upper-left panel of Figure 3.13, are non-negative, which is consistent with the assumption made earlier about the non-negative serial correlation.

Given the non-negative autocorrelation of the primary surpluses, the positive but insignificant response of the liabilities/GDP ratio to a positive primary surplus innovation is plausible under an FD regime. According to the intertemporal government budget constraint (3.6), when there is a positive shock to the surplus/GDP ratio, since the nominal liabilities are predetermined at the beginning of the period and the primary surplus is an arbitrary process, it is thus the nominal income that



Notes:

1. VAR is estimated with one lag and a constant over 1980–2010.
2. The standard error bonds are based on an asymptotic approach, and are denoted by the red dashed lines.
3. The order of Cholesky decomposition is liabilities/GDP, surplus/GDP.

Figure 3.14: Impulse responses to a positive innovation in primary surplus-to-GDP ratio: order 2

has to jump in equilibrium to balance the budget constraint. So w_t on the LHS of (3.6) moves in the same direction as s_t^* , just like what we find from the impulse responses of w_t .

The graph in the upper right panel of Figure 3.13 plots the response of s_t^* to a positive innovation in w_t . It shows that a positive shock to the total liabilities/GDP ratio has relatively small and insignificant effects on the future surplus/GDP ratio over the entire time horizon. The impulse responses indicate no significant relationship between current liabilities and future primary balances. So the future primary surplus would not adjust to limit debt accumulation. Again, this result is consistent with the situation in an FD regime.

To see whether the findings from the VAR model are robust to different ordering of the variables, we report the graphs of the impulse response functions computed from the ordering of the variables $[s_t^*, w_t]$. Such an ordering assumes an exogenous

process for total liabilities and allows for a contemporaneous effect on the primary surplus, which make more sense in an MD regime. As Figure 3.14 shows, there are no significant differences compared to Figure 3.13. The positive response of w_t to a positive shock s_t^* is significant for ten years. In addition, we examine various specifications of the model by adding two, three and four lags in the model, separately; we also examine the variables in first differences, and finally we add a deterministic trend. The conclusion that there was an FD regime in China during 1980–2010 seems quite robust to different specifications of the VAR model.

In a word, the impulse response functions from the VAR model give us clear evidence of an FD regime in China over 1980–2010. The primary surplus, inclusive of the seigniorage revenue, s_t^* , can be regarded as an exogenous process. A positive shock to s_t^* is not associated with any reduction in the real liabilities after period t . Future w_t has to adjust in order to accommodate changes in s_t^* so that the real value of government liabilities equals the expected current and future primary surpluses. However, this adjustment of the liabilities seems to be insignificant. We have thus seen little evidence favouring an MD regime for China. This finding appears to be in line with other studies in which an FD regime is a common phenomenon in developing countries (De Resende, 2007; Fry, 1998; Tanner and Ramos, 2002; Zoli, 2005).

3.5 Fiscal Dominance, the Exchange Rate Peg, and Monetary Policy in China

There are several remarkable characteristics of China’s macro economy, for example, a rapidly growing monetary base, the fast accumulation of public debt, and a pegged exchange rate against the US dollar. The first two characteristics are often associated with the concerns of the FD regime; i.e. the fiscal policy is passively adjusted to satisfy the government budget constraint. The last two characteristics are widely observed in countries with currency crises. The empirical results in Section 3.4 have already suggested a fiscal dominance, or non-Ricardian, regime in China. From 1978, the exchange rate began to play an increasingly significant role in linking China and the global economy. Given such a background, one may raise an intriguing question: does the currency peg have any implications for the government budget and the FD regime? Existing studies concerning the FD regime pay little attention to the exchange rate issue or the exchange rate regime. In those analyses, the exchange rate plays no role on either the price level or the requirements of fiscal solvency. So in a closed economy the constraints on monetary policy in a non-Ricardian regime come from the fiscal policy.

In fact, one key point of extending the analysis to an open economy is the role

of the domestic price level. The FTPL indicates that if the authority does not meet its intertemporal budget constraint, the price level would adjust to make the real liabilities equal to the present value of current and future primary surpluses. In other words, it is the fiscal policy that provides the nominal anchor. However, in an open economy with perfect capital mobility, when the central bank tries to fix the exchange rate, the purchasing power parity (PPP) condition requires that the domestic price level is determined by the foreign price level. It thus seems impossible for the price level adjustment to satisfy the requirement of fiscal solvency. Meanwhile, when a central bank targets a fixed exchange rate, the monetary policy is given less discretion: it has to meet excess supply or demand of foreign currencies by intervening in the foreign exchange market. So the amount of domestic currency is pinned down by the clearing condition in the foreign exchange market, rather than by the domestic monetary authority. According to the implication of the work by Canzoneri et al., China's exchange rate peg would eventually lead to either a Ricardian regime or a breakdown of the currency peg. Such an inference seems to be contradictory to the empirical result in the previous section. In fact, China began a currency peg unilaterally against the US dollar decades ago and successfully maintained the peg for quite a long time. To support the empirical plausibility of a non-Ricardian regime, we extend the model to incorporate the exchange rate.

In Section 3.3, we reviewed the institutional framework of the exchange rate in China since 1980, and presented two features of the PBC's balance sheet: the continued expansion of the foreign assets held by the PBC, and the rapidly growing amount of the monetary base. We believe that both of these characteristics have important implications for the budget constraint of the government inclusive of the central bank. In this section, we first describe the effect of the fixed exchange rate regime on China's money supply, using a flow-of-funds matrix approach. Next, we extend the intertemporal budget constraint model in Section 3.4 to incorporate the central bank's foreign reserves and interest-bearing liabilities. The analysis implies that it is likely that the fixed exchange rate regime remains viable in the presence of the FD regime. Finally, we draw on some international comparisons between China and some developing countries in the years before their financial crises in the 1990s. Several key features of China's condition may help us understand the different consequences of the coexistence of the fixed exchange rate and the FD regime in China and in those developing countries, such as the surpluses in the current and capital accounts, the expected appreciation of the Chinese yuan, and the PBC's strong ability to sterilize the effects of its foreign exchange intervention. Consequently, a currency crisis, which is associated with the FD regime in other countries, is less likely to break out in China.

3.5.1 *A flow of funds perspective*

The flow of funds approach provides a convenient way to see how the money supply is determined in a simplified open economy. It reflects the demand and supply of key sectors in the economy for certain financial claims. Meanwhile, it presents a portfolio of the assets and liabilities each sector holds, which is equivalent to the balance sheet of each sector in the economy. In particular, using this approach can help us understand the consequences of the PBC's intervention operations in the foreign exchange market and the subsequent sterilization operation in the money market. Those changes can be observed in the assets and liabilities held by the consolidated government sector, for example, the foreign assets and the central bank interest-bearing securities. Those factors have important implications for the monetary base, the money supply, and the price level.

The flow of funds approach we adopt follows Cobham (1998, pp. 76–79). Table 3.12 reports China's flow of funds matrix calculated using the data in 2006. We choose the year 2006 because we believe it is a reasonably typical year in which no drastic events or changes had occurred in the economy. We have four sectors in the economy: the consolidated government sector, the foreign sector, the private non-financial sector, and the financial sector. Columns (a)–(d) can be regarded as the balance sheets of those sectors. For example, the government has three key items as its assets in column (a): claims on financial sectors, domestic lending, and foreign assets. Meanwhile, it has three liabilities: high-powered money, government bonds, and central bank bills. The first item in column (a) shows the government's budget deficit. All the columns should sum to zero, as each sector must have a balanced budget. Meanwhile, rows (1)–(10) show the flows of each financial claim between the different sectors. Row (1) shows the financial deficit which is expenditure minus income of each sector. In particular in row (1), the cell (1a) is the government deficit; (1b) is the current account surplus; (1c) is the excess of private non-financial sector investment over saving; and (1d) is the net financial sector investment. Meanwhile, rows (2)–(10) show the flows of each financial claim between the different sectors. For example, row (4) shows the increased high-powered money by the government in 2006. This newly created money is an increased liability for the government, and an increased asset for the foreign sector, the private non-financial sector, and the financial sector. Each row should also sum to zero, as the supply of any financial claim must equal the demand.

Table 3.12 reveals some significant impacts of the fixed exchange rate regime on the money supply in China. First, the increase in the high-powered money, or the monetary base, is usually caused by the increase in the foreign assets held by the government. The huge amount of the rise in foreign assets reflects the PBC's strong intervention in the foreign exchange market to keep the Chinese yuan from

		(a) Government	(b) Foreign	(c) Private non- financial sector	(d) Financial sector	(e) Total
1	financial deficit	166.3	2030.1	-1806.9	-245.5	0*
2	deposits	-	4.9	5021.8	-5026.6	0
3	non-deposit liabilities	-	341.7	-214.2	-127.5	0
4	high-powered money	-1341.5	18.2	279.8	1043.5	0
5	government bonds	-279.3	-	41.0	238.3	0
6	central bank bills	-967.2	-	-	967.2	0
7	claims on financial sectors	254.8	-	-	-254.8	0
8	domestic lending	-10.6	607.8	-4013.8	3416.6	0
9	foreign claims	2243.4	-2999.3	183.8	572.3	0
10	other	42.2	-	360.6	-398.0	0
11	total	0*	0	0*	0*	0*

Notes:

1. The columns represent the balance sheet of each sector; the rows represent the supply of and demand for each financial claim.
2. The positive sign indicates an increased asset (or a reduction in liability) for some sector, and the negative sign indicates an increased liability (or a decrease in assets) for some sector.
3. The sum of the columns and rows denoted by * indicate a non-zero value, due to a lack of statistical consistency in different government sectors. However, for illustration purpose, we treat them as zero. This has little effect on the relationship among the variables of interest.
4. Some descriptions of the statistics in the table are as follows: 1a: the government deficit; 1b: the current account surplus; 1c: the excess of private non-financial sector investment over saving; 1d: the net financial investment. 2b: changes in deposits of the foreign sector at the domestic banks; 3b: changes in the shares issued by banks and held by the foreign sector; 3c: changes in the shares issued by firms and held by the financial sector; 3d: changes in the shares issued by banks; 7a: changes in the central bank's claims on financial institutions; 8a: changes in the borrowing by the government; 8b: changes in the foreign loans and foreign direct investment; 9a: changes in the foreign assets held by the central bank; 9b: the foreign exchange inflows; 9c: changes in the foreign assets held by the private non-financial sector; 9d: changes in the foreign assets held by the banks; 10a-10d: all other changes in items included in the flow of funds tables.

Source: Author's calculation; Almanac of China's Finance and Banking, 2009; the PBC's website; China Economic Information Network (CEIN).

Table 3.12: Flow of Funds Matrix of China: 2006

appreciating. On the other hand, the size of the increase in high-powered money was eight times that of the fiscal deficit. Remember that we can consider the increase in the high-powered money as the seigniorage revenue of the government. Clearly, its amount far exceeds the need to finance the fiscal deficit. Therefore, the evolution of the high-powered money was more a consequence of government policies on the exchange rate than of those on the fiscal deficit. In an extreme scenario, even if the total fiscal deficit were monetized by the PBC, the impact on the monetary base would still be moderate.

Second, the public debt issued by the MOF for budgetary purpose was only one third of the amount of the central bank bills issued contemporaneously by the PBC. The sterilization operations via the central bank bills can absorb the excess money supply created by foreign exchange purchases to push down the yuan, so that the pressure on domestic inflation is partially offset. The relative size of the government bonds against the central bank bills shows, from a perspective of the consolidated government sector, that the borrowing is to a large extent for the purpose of neutralizing the effect of external developments on domestic money supply rather than financing the fiscal deficit.

Third, under the fixed exchange rate regime, the rapidly growing foreign assets held by the government have a significant impact on the broad money supply. To see this, we use a credit counterparts approach, which links the rise in the money supply by the private non-financial sector to the assets and liabilities held by other sectors. By defining the broad money supply as the sum of the currency and deposits held by the private sector, we have

$$\Delta M_s = 2c + 4c \quad (3.18)$$

where ΔM_s denotes the changes in the broad money supply; $2c$ and $4c$ denotes the corresponding financial claims in Table 3.12. According to column b and c , and row 1 in the table, we have the following accounting identities:

$$1b + 2b + 3b + 4b + 8b = -9b \quad (3.19)$$

$$1c + 2c + 3c + 4c + 5c + 8c = -9c - 10c \quad (3.20)$$

$$1a + 1b + 1c + 1d = 0 \quad (3.21)$$

Substituting for $1b$ from (3.19) into (3.20), then for $1c$ from (3.21), and after some rearrangement, we have the following equation

$$2c + 4c = 1a - 2b - 3b - 4b - 8b - 3c - 5c - 8c - 9c - 10c + 1d \quad (3.22)$$

Equation (3.22) shows how the changes in broad money supply can be related to

changes in the following items: the government deficit (1a); all the financial claims of the foreign sector except the current account balance (2b, 3b, 4b, 8b, and 9b); shares issued by firms and acquired by the financial sector (3c); private non-financial sector's holding of Treasury bonds (5c), borrowings from financial institutions (8c), foreign assets acquired (9c) and other claims (10c); and the net financial institution investment (1d). Substituting the numbers in the equation we have

$$\begin{aligned}\Delta M_s = & 166.3 - 4.9 - 341.7 - 18.2 - 607.8 + 2999.3 \\ & + 214.2 - 41.0 + 4013.8 - 183.8 - 360.6 - 245.5\end{aligned}\quad (3.23)$$

Clearly, the foreign exchange inflows (2999.3) and the domestic bank lending (4013.8) play the dominant role in the growth of the money supply. On the other hand, the fiscal deficit (166.3) has only a limited impact on the money supply. The credit counterparts approach makes clear that the money supply increase is partly due to China's effort to maintain the fixed exchange rate regime. Given the implication of the exchange rate for the money supply and price level, it is necessary to include it in the analysis of intertemporal budget constrain.

3.5.2 An extension of the FTPL to a model with currency peg considerations

In order to examine the role of different exchange rate regimes, Canzoneri et al. (2001a) propose a model between two countries with representative households and perfect capital mobility. They argue that the nominal exchange rate is determined by the requirements of fiscal solvency, and the central bank is incapable of maintaining a currency peg in a non-Ricardian regime. When the interest rate parity and purchasing power parity hold in a non-Ricardian regime, the central bank will lose its ability either to set the interest rate or to target the price level. Thus in the government's intertemporal budget constraint, neither the seigniorage nor the price level would accommodate the needs of fiscal solvency. As a result, a current positive shock to the primary surplus can only be compensated by a decrease in the present value of the future primary surplus, which means that there must be a monetary dominance regime. They conclude that a currency peg is not credible in a non-Ricardian regime, in a sense that a Ricardian regime is necessary condition for a fixed exchange rate to be viable.

Daniel (2001), whose main conclusions are similar to Canzoneri et al. (2001a), also focuses on the consequences of a binding government budget constraint under a fixed exchange rate regime. If the government changed the path of current and future primary surpluses inclusive of seigniorage, there would be an exchange rate crisis. The foreign reserves would be exhausted eventually, and the exchange rate

would collapse. Therefore, it is the fiscal policy that should be responsible for such an exchange rate crisis. The model used by Daniel seems to fit the context of developing countries more, because it considers the role of foreign reserves, as well as the impact of sterilization operations by the central bank. If the central bank can sell long-term government bonds, the date of the currency peg collapse can be postponed to some extent.

Given the limited amount of relevant literature, we closely follow the approaches of Canzoneri et al. (2001a) and Daniel (2001) to develop the consolidated government budget identity discussed in Section 3.4. Two crucial differences of the model are noteworthy with regard to the studies mentioned above. Firstly, the central bank in China faces an excess supply of foreign currency at a pegged exchange rate. Therefore, the domestic currency is under the pressure of appreciation rather than depreciation. A lot of existing studies only consider the conditions of declining foreign reserves, for example, the situations of continued current deficits in the balance of payments. The situation we explore here involves fundamental differences from the conventional analyses, which have not yet been widely addressed.

The second notable feature of the analysis is that the central bank is allowed to issue interest-bearing securities in the model. This specification fits what we have reviewed earlier in the institutional setup of the PBC. The issuing of central bank bills, as a powerful instrument of sterilization operations, could affect the composition of the overall liabilities of the consolidated government sector. The corresponding interest payment cost also plays a role in the budget constraint of the government sector. Thus, we will modify the model used by Canzoneri et al. (2001a) and Daniel (2001). However, introducing the central bank bills naturally raises the question of whether the amount of central bank bills could increase indefinitely. We will discuss this issue later in this section.

Conventionally, the government's intertemporal budget constraint is discussed in a context of the private sector's optimizing behaviour. So we first specify the behaviour of the household. In a model of the representative household with perfect foresight and strict capital control, we assume that the household maximizes its total utility, in terms of a money-in-the-utility (MIU) function:⁴³

$$U_t = E_t \sum_{t=0}^{+\infty} \beta^t \left[u(c_t) + \nu \left(\frac{M_t}{p_t} \right) \right] \quad (3.24)$$

where E_t is the expectations operator. c_t is the real consumption of the household; $\frac{M_t}{p_t}$ is the stock of real money balances. u and ν are increasing, strictly concave, and

⁴³It is conventional to use the MIU model in the analysis of fiscal dominance. Since there is an opportunity cost of holding money, the major purpose of introducing money in the utility function and assuming money yields utility is to ensure a positive demand for money. See Walsh, 2003, p. 80.

continuously differentiable. β is the subjective rate of discount which is between 0 and 1.

The representative household chooses time paths for consumption and real money balances, but is subject to the following budget constraint

$$p_t c_t + M_t + \frac{B_t^T + B_t^{CB}}{(1 + i_t)} + p_t \tau_t = M_{t-1} + B_{t-1}^T + B_{t-1}^{CB} + p_t y_t \quad (3.25)$$

where B_t^T and B_t^{CB} are the face value of the securities issued by the Ministry of Finance and the PBC at time t , respectively. i_t is the nominal domestic interest rate. τ_t is the real lump-sum tax payments. y_t is the household's real income. Equation (3.25) implies that the household's purchase of consumption, its nominal money holding, bonds, and tax payment, should be equal to the sum of resources carried over from the previous period, $t - 1$, and the nominal income in period t .

The representative household maximize (3.24) subject to (3.25), so we have the Lagrangian formulation

$$L = E \sum_{t=0}^{+\infty} \beta^t \left\{ u(c_t) + \nu \left(\frac{M_t}{p_t} \right) + \lambda_t [M_{t-1} + B_{t-1}^T + B_{t-1}^{CB} + p_t y_t - \left(p_t c_t + M_t + \frac{B_t^T + B_t^{CB}}{(1 + i_t)} + p_t \tau_t \right)] \right\} \quad (3.26)$$

The first-order Euler equation with respect to c_t , M_t , B_t^T and B_t^{CB} for maximization imply

$$\frac{1}{1 + i_t} = E_t \left[\alpha_t \left(\frac{p_t}{p_{t+1}} \right) \right] \quad (3.27)$$

$$\nu' \left(\frac{M_t}{p_t} \right) = u'(c_t) \left(\frac{i_t}{1 + i_t} \right) \quad (3.28)$$

where $\alpha_t = \beta \frac{u'(c_{t+1})}{u'(c_t)}$. Canzoneri et al. (2001a) refer to equation (3.27) as the condition of optimal intertemporal smoothing of consumption. And equation (3.28) implies that the marginal utility of holding money should be equal to the marginal disutility of consumption foregone. As u and ν are assumed to be concave, equation (3.28) can be regarded as the money demand function

$$\frac{M_t}{p_t} = h(i_t, c_t) \quad (3.29)$$

As we have mentioned earlier, in addition to the debt issued by the Ministry of Finance, B_t^T , the central bank is allowed to issue its own interest-bearing liability, B_t^{CB} , to curb liquidity in the money market. By following Daniel (2001), we also take into account the holding of foreign assets by the PBC, F_t , denominated in foreign

currency. F_t is regarded as an asset of the government. e_t is the exchange rate, in terms of the domestic currency price of foreign currency (for example, $e_t=6.62$ RMB/\$US in 2010). We extend our analyses in the previous section and express the intertemporal government constraint as

$$(M_t - M_{t-1}) + \frac{B_t^T + B_t^{CB}}{1 + i_t} + T_t + i_t^* F_{t-1} e_t = B_{t-1}^T + B_{t-1}^{CB} + G_t + (F_t - F_{t-1}) e_t \quad (3.30)$$

where i_t^* denotes the foreign nominal interest rate of period t . Equation (3.30) implies that at time t , the government's total revenue must equal its total expenditure. Total revenue on the LHS of equation (3.30) consists of money creation, government borrowing (including the PBC's borrowing in the money market), tax revenue, and returns on the PBC's foreign assets. Total expenditure on RHS of equation (3.30) includes redemption of the maturing debt, government expenditure, and purchase of foreign assets. After some rearrangement, we scale all the terms by the nominal income, $p_t y$. We assume a constant real income over time for the sake of simplicity. Equation (3.30) can be written as

$$\begin{aligned} \frac{M_{t-1} + B_{t-1}^T + B_{t-1}^{CB} - (i_t^* F_{t-1} + F_{t-1}) e_t}{p_t y} = \\ \frac{M_t + B_t^T + B_t^{CB} - (i_{t+1}^* F_t + F_t) e_t}{(1 + i_t) p_t y} \\ + \frac{(T_t - G_t)}{p_t y} + \frac{i_t M_t}{(1 + i_t) p_t y} + \frac{(i_{t+1}^* - i_t) F_t e_t}{(1 + i_t) p_t y} \end{aligned} \quad (3.31)$$

As in Section 3.4, we set the ratio of primary surplus to GDP, $\frac{(T_t - G_t)}{p_t y}$, as s_t ; the seigniorage to GDP ratio, $\frac{i_t M_t}{(1 + i_t) p_t y}$, is set as θ_t . In addition, we set $\frac{(i_{t+1}^* - i_t) F_t e_t}{(1 + i_t) p_t y}$ as f_t , which reflects the net return on holding foreign reserves by the PBC. Iterating equation (3.31) forward, and using the first order Euler condition (3.27), we obtain

$$\begin{aligned} \frac{M_{t-1} + B_{t-1}^T + B_{t-1}^{CB}}{p_t y} - \frac{(1 + i_t^*) F_{t-1} e_t}{p_t y} = \\ (s_t + \theta_t + f_t) + E_t \left[\sum_{n=t+1}^{+\infty} \prod_{k=t}^n \alpha_k (s_n + \theta_n + f_n) \right] \\ + \lim_{n \rightarrow \infty} E_t \left[\prod_{k=t}^{t+n} \alpha_k \left(\frac{M_{t+n} + B_{t+n}^T + B_{t+n}^{CB}}{p_{t+n+1} y} - \frac{(i_{t+n+1}^* F_{t+n} + F_{t+n}) e_{t+n}}{p_{t+n+1} y} \right) \right] \end{aligned} \quad (3.32)$$

Equation (3.32) implies that the real value of government liabilities minus its holding of foreign assets at the beginning of period t , must be equal to the present value of the current and future primary surplus, seigniorage, and the return on foreign assets, plus a limit term. On the assumption that the government satisfies the no

Ponzi condition, the last term in equation (3.32) is set to zero.⁴⁴

$$\lim_{n \rightarrow \infty} E_t \left[\prod_{k=t}^{t+n} \alpha_k \left(\frac{M_{t+n} + B_{t+n}^T + B_{t+n}^{CB}}{p_{t+n+1}y} - \frac{(i_{t+n+1}^* F_{t+n} + F_{t+n})e_{t+n}}{p_{t+n+1}y} \right) \right] = 0 \quad (3.33)$$

Assuming that purchasing power parity holds, under a pegged exchange rate, the domestic price level is pinned down by the targeted exchange rate. If we fix the foreign price level to be 1, fixing the exchange rate is equivalent to fixing the domestic price level, or $p_t = e_t = \bar{e}$, where \bar{e} is the pegged exchange rate parity. Equation (3.32) can then be written as

$$\begin{aligned} \frac{M_{t-1} + B_{t-1}^T + B_{t-1}^{CB}}{\bar{e}y} &= (s_t + \theta_t + f_t) \\ &+ E_t \left[\sum_{n=t+1}^{+\infty} \prod_{k=t}^n \alpha_k (s_n + \theta_n + f_n) \right] + \frac{(1 + i_t^*)F_{t-1}}{y} \end{aligned} \quad (3.34)$$

Equation (3.34) is the intertemporal budget constraint of the consolidated government sector, which is similar to the one we have examined in Section 3.4. But (3.34) is more appropriate for an emerging and open economy.

Equation (3.34) has several important implications. First, as the exchange rate is fixed at the target level, and all the nominal liabilities are predetermined at the beginning of period t , the real government liabilities, as expressed on the LHS of (3.34), are also predetermined at the beginning of period t . Second, because the exchange rate regime fixes domestic price at \bar{e} , the future expected inflation rate would be zero. According to equation (3.27), the domestic interest rate is determined by $E_t \left[\alpha_t \left(\frac{p_t}{p_{t+1}} \right) \right]$, which must thus be constant over time. Third, recall that $f_t = \frac{(i_{t+1}^* - i_t)F_t}{(1+i_t)y}$, so if the central bank buys all the excess foreign currency to control the value of the Chinese yuan, and i_t is fixed by the monetary policy, while F_t is exogenously determined in the foreign exchange market, then we have the sequence of f_t as an exogenous process.

As long as equation (3.34) holds, we say that the set of fiscal and monetary policy is sustainable. As the empirical results in Section 3.4 were consistent with the existence of a non-Ricardian regime rather than a Ricardian one, we focus on the former in the following analysis. A non-Ricardian regime can be defined as one in which the primary surplus inclusive of seigniorage, $\{s_t + \theta_t\}$, is an exogenous process without regard to the initial level of liabilities. A key argument made by Canzoneri et al. (2001a) and Daniel (2001) is that under such a regime, the currency peg would not be credible. Their conclusion can also be illustrated in our model. In equation

⁴⁴It is conventional to assume the no Ponzi condition in characterising the paths of dynamic economic models. It implies that the present discounted value at infinity must be zero. The no Ponzi condition is used to rule out the possibility of over-accumulation of government liabilities.

(3.34), central bank has to fix the money supply to maintain the currency peg, so the seigniorage is not determined by the central bank; in other words, $\{\theta_t\}$ is also an exogenous process. Then if there is a shock to s_t , since neither seigniorage nor future s_t would adjust in response, only the exchange rate can balance equation (3.34). Since the currency peg must be maintained (because of political considerations; or to stick to some commitment), the only way the budget can be balanced is the adjustment of future s_t . This would lead to a de facto Ricardian regime, that is, active fiscal policy is responsible for balancing the intertemporal government budget constraint. Daniel (2001) also argues that the central bank can adjust $\{\theta_t\}$ through issuing long-term government bonds. However, the foreign reserves would eventually be exhausted, and monetary policy would have to give up the peg.

Those findings are consistent with the conclusions in a standard Krugman-Flood-Garber model (KFG or first generation model, see Krugman (1979), and Flood and Garber (1984)) of balance of payments crisis, which focuses on the links between persistent budget deficits and balance of payment crisis. The model implies that a fixed exchange rate will not be sustainable if the government runs a persistent budget deficit. Speculative attacks on the domestic currency take place before the central bank has run out of its foreign reserves. There are some historical examples to support this argument that a currency crisis might be triggered by a lack of fiscal discipline under a fixed exchange rate regime, for example, the capital flight out of Latin American countries in the 1970s and 1980s.⁴⁵ During the Asian Financial Crisis in 1997, the anticipated, rather than the previous, fiscal deficits, are argued to have been a substantial cause of the crises in South Korea and Thailand. The prospective deficits were caused by the government's bailouts to financial institutions.⁴⁶

However, the link mentioned above between exchange rate regime and fiscal policy seems to be less robust in the context of China. We will illustrate this from both the fundamental perspective and the institutional perspective. Firstly, when compared to Latin American and African countries in the 1980s and early 1990s, China is in quite a similar situation. Those common features include fast economic growth, massive capital inflows, a marked accumulation of foreign reserves, and significant pressure for real appreciation. However, there is a crucial underlying difference: while there had been current account deficits in those Latin American countries, China has been experiencing a persistent current account surplus since 1994. The foreign money inflow into China can be distinguished by different motivations, including the trade surplus of China's exporters, foreign direct investment for medium and long term opportunities, and purely speculative inflows from abroad. So the real appreciation pressure in China is associated with both trade surplus and capital inflows; in Latin American countries in the episode of the 1980s, the capital account

⁴⁵See Hossain and Chowdhury, 2000, p. 126; Obstfeld and Rogoff, 1996, pp. 558–59.

⁴⁶See Burnside et al., 1998.

surpluses were largely financed by the current account deficits.⁴⁷ If there is a sudden capital flight (capital outflows) in China, the effect would be cushioned by the current account surplus.

The episode of the double surpluses (current account and capital account) and the resulting foreign reserves surge in China has important implications for the government solvency illustrated in equation (3.34). As we have discussed, in a conventional KFG model with a fixed exchange rate regime, when the monetary policy generates seigniorage revenue to finance fiscal needs, its holding of foreign reserves falls in exchange for the increased money supply, so that the exchange rate can be fixed at the previous level. In equation (3.34), this process is equivalent to a decrease in f_t , caused by a decrease in s_t . It is obvious that equation (3.34) cannot be balanced in this way, so the exchange rate peg must be abandoned. But under a condition of double surpluses, excess demand for domestic money would remove the inconsistency between monetary policy and fiscal policy. If there is a fiscal need to raise seigniorage, the monetary authority can increase money supply without selling its holding of foreign reserves. Thus, when there is a negative shock to the primary surplus s_t , current and future seigniorage θ_t is able to increase without violating the exchange rate peg.

If the government deficit is exogenously determined, but the monetization of home government debt does not take priority as the central bank's monetary policy goal (that is, θ_t is also exogenously determined by the monetary authority, which is possible with the help of central bank sterilization operations), the intertemporal government budget constraint can still be balanced while the fixed exchange rate is well defended. In equation (3.34), the return on foreign reserves f_t also increases because of the mounting foreign reserves, assuming other variables (i_{t+1}^* , i_t , and y) remain constant. Accordingly, the fiscal authority could benefit from the seigniorage revenue attributed to the excess demand for domestic currency. A negative shock to s_t could be dealt with by the combination of positive changes in θ_t and f_t , while the fixed exchange rate remains viable.

But can the central bank deal with a surge in the monetary base while keeping the peg credible, but without help from the fiscal authority in the presence of a non-Ricardian regime? We will discuss this issue from an institutional perspective. The key factor is the interest-bearing securities issued by the PBC, B_t^{CB} . Conventionally, the foreign-reserve-backed monetization caused by a substantial degree of central bank intervention gives rise to concern over excessive liquidity and future inflation. Then consider a simplified balance sheet of the central bank who can issue securities

$$e_t F_t = A_t + K_t \quad (3.35)$$

⁴⁷See Calvo et al., 1992.

where $e_t F_t$ is the domestic value of foreign assets, which is also the only source of total assets held by the central bank. K_t denotes the central bank's total equity. A_t denotes the total liabilities, consisting of the monetary base and central bank bills issued.

$$A_t = M_t + B_t^{CB} \quad (3.36)$$

When the central bank sells its securities in the money market in exchange for the increased money, the monetary base M_t is reduced from the level it would have reached. Given this operation illustrated in equation (3.36), the central bank can set the nominal money supply to achieve any desired target for the LHS of equation (3.34). The PBC's central bank bills are particularly important for the practice of monetary policy in China when international demand for China's currency substantially exceeds increased money supply resulting from seigniorage needs. For example, in 2008, the annual increment of central bank bills issued was 1131.07 billion yuan, while the foreign reserves and monetary base increased by 3771.83 billion yuan and 2767.7 billion yuan, respectively; on the other hand, the primary surplus was only 14.1 billion yuan. It can be inferred that, at least in those years when the foreign reserves of the PBC soared, the raising of seigniorage revenue was less likely to be a major concern of the monetary authority.

The key argument we have made so far focuses exclusively on the coexistence of fiscal sustainability and fixed exchange rate sustainability. Given the theoretical and practical possibilities discussed above, a fixed exchange rate regime is feasible in the presence of a non-Ricardian regime. The viability of the fixed exchange rate regime depends heavily on two aspects: first, there should be a positive excess demand for the domestic currency (in our case, it is the Chinese yuan). The inconsistency between the monetary policy and the fiscal policy, which is a leading source of exchange rate collapse in the KFG model, is therefore no longer a problem in the model. Second, the central bank can issue its own interest-bearing securities to sterilize the impact of foreign exchange inflows. The monetary base becomes controllable; given a strict capital control, the interest rate can be restored to the level that would exist without foreign exchange inflows. Therefore, the monetary policy does not lose at least all its independence, regarding its control on both exchange rate and monetary base. Under certain circumstances we have mentioned, the conclusion from Canzoneri et al. (2001a), Daniel (2001) and the KFG model may not be regarded as a valid general theorem.

3.5.3 The sustainability of the sterilization operations

As long as the PBC's sterilization operation is sustainable, it is possible for the PBC to maintain the fixed exchange rate regime even under a non-Ricardian regime. One

remarkable advantage of issuing central bank bills is that there is imperfect substitutability between the central bank bills and foreign bonds (for example, the US T-bills) in the portfolios of the financial institutions in China. Under heavy administration and supervision on the banking system, most commercial banks are not allowed to trade foreign bonds. Therefore, selling central bank bills to the domestic banks can be quite useful in sterilizing the PBC's intervention operations in the foreign exchange market.

Intuitively, the sterilization cannot be carried out indefinitely. First, at some point there might be no more room for the commercial banks to absorb the bills issued by the central bank. When the capacity to purchase central bank bills reaches an upper limit, even under much greater regulatory pressure, no more central bank bills could be purchased. One extreme scenario is that commercial banks spend all their assets to get the central bank bills. Once the limit is reached, the PBC would then lose its control over the monetary base. The issues related to the capacity of commercial banks to buy central bank bills are beyond the discussion of this section because it relates more to the institutional issues of China's financial system as a whole, but has less to do with the intertemporal government budget constraint.

A second issue that may affect the sustainability of sterilization policy is the cost of such a policy. Note that the monetary authority does not pay interest on the monetary base; it does so, however, for the central bank bills. The sterilization costs can be partially offset by the return on the central bank's holding of foreign assets, but when the interest differential changes inversely, the condition of a fixed exchange rate regime under a non-Ricardian regime may not be sustainable, leading to a collapse of either the fixed exchange rate regime or the non-Ricardian regime. In particular, the sterilization may become quite expensive if the interest earned by the foreign reserves is too small, or the interest paid to the owners of central bank bills is too high.

The second issue mentioned above in the presence of excess foreign exchange supply at a fixed exchange rate is discussed by Frenkel (2007). He points out that there is a maximum level for the domestic interest rate that allows the sterilization policy to be sustainable. The higher this maximum domestic interest rate is, the more flexibility the central bank would have on its monetary policy. We follow Frenkel's model because it captures two essential characteristics of the context in China we have mentioned earlier: the issue of interest-bearing securities by the central bank, and the excess supply of foreign exchange in the foreign exchange market. It is noteworthy that the interest rate plays an extremely limited role in signalling the changes in demand and supply of money, given the strong influences of the fiscal and monetary authorities on the financial institutions, and a slow process of interest rate liberalization. So far the PBC still depends heavily on non-price instruments rather

than interest rates, for example, the reserve requirement ratio and the central bank bills. Thus, instead of following Frenkel's model by looking at the domestic interest rate, we will focus on the maximum amount of central bank bills that can be issued by the PBC, and examine its relationship with certain economic fundamentals.

According to the simplified central bank balance sheet (3.35) and the definition of total liabilities, we have

$$\Delta A_t = \Delta M_t + \Delta B_t^{CB} = J_t e_t + i_t B_{t-1}^{CB} \quad (3.37)$$

where Δ is the first difference operator, J_t is the excess supply of foreign exchange denominated in foreign currency, and i_t is the domestic interest rate. Equation (3.37) indicates that the increase in total liabilities is the sum of the increase in monetary base and the increase of outstanding central bank bills, which is equal to the purchase of excess foreign exchange supply plus interest payments on the central bank bills issued in period $t - 1$ and maturing in period t .

Meanwhile, on the total assets side of the balance sheet, the increase can be expressed, in terms of domestic currency, as

$$\Delta(e_t F_t) = \Delta e_t F_{t-1} + J_t e_t + e_t i_t^* F_{t-1} \quad (3.38)$$

Equation (3.38) states that the increase in foreign reserves consists of three parts: the increase in foreign reserves at the beginning of the period due to currency appreciation, $\Delta e_t F_{t-1}$; the intervention in the foreign exchange market, $J_t e_t$; and the yield of foreign reserves, $e_t i_t^* F_{t-1}$.

Express the central bank balance sheet in terms of first difference, we have

$$\Delta(e_t F_t) = \Delta A_t + \Delta K_t \quad (3.39)$$

Based on the balance sheet above, Frenkel (2007) proposes a criterion of sterilization policy sustainability. That is, to avoid any loss of the capital the central bank holds, the increase in total liabilities should be less than the increase in total assets. In other words, to make sure that ΔK_t is non-negative, we must have

$$\Delta(e_t F_t) \geq \Delta A_t \quad (3.40)$$

According to equation (3.37)–(3.40), we have

$$\Delta e_t F_{t-1} + J_t e_t + e_t i_t^* F_{t-1} \geq J_t e_t + i_t B_{t-1}^{CB}$$

Given that the nominal interest rate can never be negative, divide both sides by i_t

$$B_{t-1}^{CB} \leq \frac{\Delta e_t F_{t-1} + e_t i_t^* F_{t-1}}{i_t} \quad (3.41)$$

Equation (3.41) implies some kind of upper limit for the amount of central bank bills, which is positively associated with Δe_t , F_{t-1} , e_t , i_t^* , and negatively with i_t . Divide both sides of (3.41) by the domestic currency value of foreign reserves $e_{t-1} F_{t-1}$ at the beginning of period t

$$b_t^{CB} \leq \frac{\Delta e_t / e_{t-1} + i_t^* e_t / e_{t-1}}{i_t} \quad (3.42)$$

where $b_t^{CB} = \frac{B_{t-1}^{CB}}{e_{t-1} F_{t-1}}$ is the ratio of central bank bills to total foreign reserves. In particular, if we consider a fixed exchange rate regime, equation (3.42) can be written as

$$b_t^{CB} \leq \frac{i_t^*}{i_t} \quad (3.43)$$

Equation (3.43) provides some interesting implications. If $b_t^{CB} \leq 1$, the domestic interest rate can exceed its foreign counterpart, without affecting the sustainability condition. Given the foreign interest rate and a large b_t^{CB} at the beginning of period t , the sustainability condition requires a substantially lower domestic interest rate compared to foreign counterpart. Otherwise, there would be a substantial interest payment burden due to the high level of outstanding central bank bills. On the other hand, if initially b_t^{CB} is relatively small and the foreign interest rate is given, there would be much room for the domestic interest rate to rise while maintaining the sustainability condition. Therefore, the central bank which depends heavily on issuing central bank bills to fight inflationary pressure would have its interest rate policy subject to a cost constraint.

In order to illustrate the conditions discussed above, we calculate some relevant variables with the data of China in 2010 as a numerical example. There are no official statistics or estimates of the composition of China's foreign reserves held in foreign currency denominated assets, so no precise empirical analysis could be made. It is not surprising that China has become one of the major purchasers of US Treasury securities. According to a US Congressional Report Service report, by June 2006 China had invested \$699 billion, or 74.3 per cent, of its foreign reserves in US securities (Morrison and Labonte, 2008). To provide a rough analysis, we take the yield on US 10-year Treasury securities as a proxy of the return on the PBC's holding of foreign assets. We also choose the yield on 1- year central bank bills as the representative interest rate of B_t^{CB} . At the beginning of 2010, the amount of the PBC's foreign reserves was 18.533 trillion yuan, and the outstanding amount of central bank bills was 4.206 trillion yuan. Thus, the ratio b_t^{CB} was 0.227. Table 3.13

reports the yields on 10-year US Treasury securities and 1-year China central bank bills. It can be seen that the sustainability condition (3.43) is always satisfied.

	i_t^*	i_t	i_t^*/i_t
2010-01	1.37	1.93	0.71
2010-02	1.42	1.93	0.74
2010-03	1.51	1.93	0.78
2010-04	1.50	1.93	0.78
2010-05	1.31	1.93	0.68
2010-06	1.26	2.09	0.60
2010-07	1.24	2.09	0.59
2010-08	1.02	2.09	0.49
2010-09	0.91	2.09	0.43
2010-10	0.53	2.29	0.23
2010-11	0.67	2.34	0.29
2010-12	1.04	2.51	0.41

Notes:

1. i_t^* is the yield on 10-year US Treasury securities. Source: website of the Federal Reserve.
2. i_t is the yield on 1-year China central bank bills. Source: website of the PBC.

Table 3.13: Yields on 10-year US Treasury securities and 1-year China central bank bills

However, two facts should be noted here. First, assume that all the foreign securities the PBC holds are 10-year Treasury bonds, and assume that all the central bank bills mature in one year, then the negative differential between the two rates indicates that, the more the amount of central bank bills the PBC issues, the greater the loss would be. Such a loss would become larger especially when the Federal Reserve initiated quantitative easing (QE) in the aftermath of the financial crisis in 2008, while China raised interest rates to fight inflationary pressure due to the record fiscal stimulus in the past two years. Such a concern about sterilization policy is reflected in a decreasing i_t^*/i_t ratio reported in Table 3.13. In fact, the i_t^*/i_t ratio has declined sharply since the end of 2008. This, together with the sustainability condition (3.43), contribute to a slow growth in both the foreign reserves and central bank bills during 2008–10. In September 2010, Xiaolian Hu, the vice-governor of the PBC, expressed clearly a concern about the accumulation of the PBC’s foreign reserves: “Once a reserve currency’s value becomes unstable, there will be quite large depreciation risk for assets.”

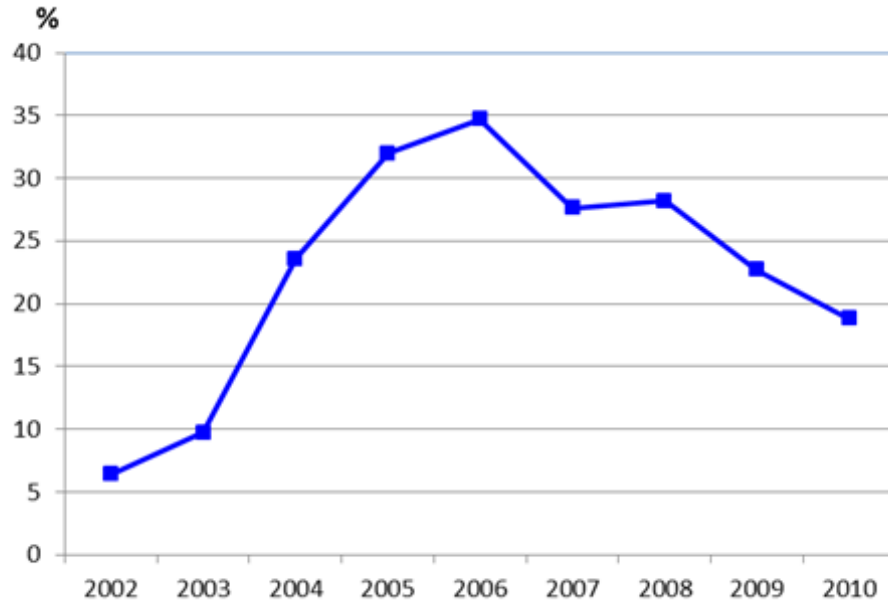
Second, the yield on 1-year central bank bills is substantially below the contemporaneous prime lending rate. Take 2010 as an example: the primary lending rate at the year end was 5.81, but the interest rate the PBC pays the domestic banks on central bank bills was 2.51. Thus, the cost of sterilization policy is partly transferred from the PBC to the rest of the banking system in China. The opportunity

cost makes the commercial banks reluctant to hold central bank bills. In addition, like the rising reserve requirement ratio in recent years, the rapid accumulation of central bank bills on the PBC's balance sheet would greatly reduce the efficiency of credit in the banking sector and distort resource allocation in the economy.

Furthermore, as equation (3.43) proposes an upper limit for b_t^{CB} , if b_t^{CB} tends to decrease or remain constant over time, (3.43) is more likely to hold eventually, which implies a more sustainable sterilization operation. That is

$$\Delta(b_t^{CB}) \leq 0 \quad (3.44)$$

According to Frenkel (2007), (3.44) is called a permanence condition of sustainable sterilization policy. Figure 3.15 shows the evolution of b_t^{CB} during 2002 and 2010. Clearly, before 2006 the permanence condition is not satisfied, as b_t^{CB} increased significantly. It is noteworthy that violation of condition (3.44) does not mean that the sustainable condition (3.43) is not satisfied.



Source: author's calculation.

Figure 3.15: The ratio of central bank bills to the foreign reserves

From the definition of b_t^{CB} we have

$$\frac{B_{t-1}^{CB}}{\bar{e}F_{t-1}} - \frac{B_{t-2}^{CB}}{\bar{e}F_{t-2}} = \frac{B_{t-1}^{CB} \cdot \bar{e}F_{t-2} - B_{t-2}^{CB} \cdot \bar{e}F_{t-1}}{\bar{e}F_{t-1} \cdot \bar{e}F_{t-2}} \leq 0$$

Since both $\bar{e}F_{t-1}$ and $\bar{e}F_{t-2}$ are positive, the numerator above should be less than zero. We set all the terms in period t

$$B_t^{CB} \cdot \bar{e}(F_t - \Delta F_t) - (B_t^{CB} - \Delta B_t^{CB}) \cdot \bar{e}F_t \leq 0 \quad (3.45)$$

Together with (3.37) and (3.38), and after some rearrangements, we have

$$\frac{J_t}{F_t} \leq \frac{b_{t+1}^{CB}}{(1 - b_{t+1}^{CB})} \left(\frac{\Delta M_t}{B_t^{CB}} + \frac{i_t^* F_{t-1}}{F_t} - \frac{i_t B_{t-1}^{CB}}{B_t^{CB}} \right) \quad (3.46)$$

Recall the demand for money is given in equation (3.29)

$$\frac{J_t}{F_t} \leq \frac{b_{t+1}^{CB}}{(1 - b_{t+1}^{CB})} \left(\frac{h(i_t, c_t)p_t - h(i_{t-1}, c_{t-1})p_{t-1}}{B_t^{CB}} + \frac{i_t^* F_{t-1}}{F_t} - \frac{i_t B_{t-1}^{CB}}{B_t^{CB}} \right) \quad (3.47)$$

The permanence condition (3.47) imposes a restriction on the flow of foreign currency purchased by the central bank as a proportion of total foreign reserves. As long as the excess supply of foreign currency satisfies (3.47), the degree of freedom of domestic monetary policy would not decrease, which is good for the central bank. The foreign exchange the central bank has to purchase to defend the fixed exchange rate is positively related to b_{t+1}^{CB} . So the larger J_t is, the larger b_{t+1}^{CB} has to be to make sure (3.47) holds. The foreign exchange purchase, which satisfies condition (3.47), also depends on the foreign interest rate and the ratio of increase in nominal money demand to interest-bearing liabilities; but negatively on the domestic interest rate.

3.5.4 Comparisons with some emerging market economies

A number of studies on financial crises in emerging market economies focus on the financial and banking aspects. As we have discussed, the fiscal problems are also likely to produce financial crises. Usually, a financial crisis covers one or more of a banking system crisis, a public debt crisis, and a currency crisis. To discuss the first two crises is beyond the scope of this section. Instead, we focus on issues relevant to currency crisis. The cases of currency crises in developing countries in the 1990s embody compelling lessons for the sustainability conditions for an exchange rate peg under a fiscal dominance regime. The comparisons provide us with a wider scope for examining the viability of a fixed exchange rate in the context of fiscal dominance.

To draw on comparisons from a historical perspective, we choose some developing countries of different period: Argentina (1992–94; 1999–2001), Brazil (1995–97), Mexico (1991–93), and Turkey (1997–99). A three-year time window is chosen before the crises broke out in those countries. In order to account for the global financial crises and economic slowdown after 2008, we present the indicators of China over two sub-periods: 2005–07, and 2008–10. As we shall see, a lot of common features can be observed between China today and those developing countries in the run-up to their crises. For example, there has been fast economic growth, persistent fiscal deficits, a massive capital inflow, and an exchange rate pegged to a foreign currency. More importantly, some notable differences can also be observed. All these can help

us understand the challenges of the coexistence of a fixed exchange rate regime and a less disciplined fiscal policy.

Table 3.14 reports selected economic indicators of five countries: Argentina (1992–94; 1999–2001), Brazil (1995–97), Mexico (1991–93), Turkey (1997–99) and China (2005–07; 2008–10). For comparability purpose, some of the indicators are scaled to either nominal GDP or total assets of the central bank. Clearly, the indicators in Table 3.14 exhibit some similarities between China and the other four emerging market economies. First, the exchange rate peg has been used as a nominal anchor in all five countries. With a currency peg, the rate of domestic inflation was substantially dampened since the domestic price converged towards that of the anchor country. For example, the rate of CPI inflation dropped from 2314.0 per cent to 171.7 per cent in Argentina in 1991; from 2075.9 per cent to 66.0 per cent in Brazil in 1994; from 114.2 per cent to 20.0 per cent in Mexico in 1989; and from 106.3 per cent to 88.5 per cent in 1995. In addition, with a pegged currency, uncertainties in exporting and foreign investment were effectively reduced, which contributed to the economic growth of these developing countries. Such a peg, however, is widely believed to have resulted in an overvalued currency which triggered the currency attacks in those four countries. For example, in Mexico in 1994, the fear of the savers and investors that the central bank of Mexico might not be able to convert domestic currency into foreign currency at the pegged exchange rate finally forced a 30 per cent devaluation of the peso.⁴⁸

Second, large surpluses in the capital account are quite common in all the countries in the selected periods. In particular, foreign investment has played an active role in creating such surpluses in all countries. Large capital inflows are argued to be productive and helpful to economic development in developing countries. However, a surge in capital inflows can also result in the accumulation of foreign reserves, an appreciation of the real exchange rate, and current account deficits. More vulnerability may arise during the process of capital account liberalization.

On the other hand, Table 3.14 also reveals several notable differences between China and other countries. First, China has the largest central bank-held foreign reserves, which account for 81.0 per cent of the PBC's total assets. As we have discussed earlier, the rapid accumulation of foreign reserves suggests an undervalued Chinese yuan, since the PBC has to purchase foreign currency to keep the exchange rate fixed. By contrast, the goal of central banks in Argentina, Brazil, Mexico and Turkey was to prevent their currencies from depreciating by selling their foreign reserves in exchange for domestic currencies. Regardless of whether the PBC is willing to do so, it does not have to worry about a scenario of zero foreign reserves. This is a fundamental difference between China's current situation and those of

⁴⁸See Mishkin, 2010, p. 452.

	Argentina (1992–94)	Argentina (1999–2001)	Brazil (1995–97)	Mexico (1991–93)	Turkey (1997–99)	China (2005–07)	China (2008–10)
Foreign reserves (% of total assets)	32.9	8.2	41.3	55.9	72.8	67.2	81.0
Monetary base (% of total assets)	32.5	5.9	34.1	37.0	20.8	60.9	65.7
Primary surplus (% of GDP)	-1.2	0.6	-0.3	4.4	2.3	-0.0	-1.0
Public debt (% of GDP)	30.8	54.1	26.9	35.9	40.4	13.0	15.4
Current account (% of GDP)	-3.4	-2.9	-2.9	-5.6	-0.3	9.0	7.2
Capital account (% of GDP)	3.9	0.1	3.0	6.3	0.4	3.0	3.0
CPI inflation	13.2	-0.2	29.6	16.0	78.4	2.7	2.8
Exchange rate regime	Currency board	Currency board	Pegged	Pegged	Pegged	Managed float	Pegged
Central bank securities	no	no	no	no	no	yes	yes

Note: The indicators reported are the three-year average before the financial crisis took place in Argentina (1995; 2002), Brazil (1998), Mexico (1994), and Turkey (2000).

Source: 1) Author's calculations. 2) The World Bank. 3) Argentina: IFS; Henming et al. (2003). Brazil: IFS; Giambiagi and Ronci (2004). Mexico: IFS; the Banco De Mexico. Turkey: IFS. China: the Ministry of Finance; the People's Bank of China.

Table 3.14: Selected economic indicators

the other countries in the 1990s. The PBC's purchase, rather than sales, of foreign currencies, has also resulted in a substantial growth of the monetary base. The ratio of the monetary base to total liabilities of the central bank in China during 2008 and 2010, 65.7 per cent, is the highest among all five countries.

The following remarkable difference between China and other countries is in the balance of the current account. While China has had a surplus in its current account, all the other countries experienced persistent current account deficits before the crises. The deficit varied from 0.3 per cent of GDP in Turkey, to 5.6 per cent of GDP in Mexico. The deficits were partly caused by the overvalued exchange rates: exports were reduced by lower external competitiveness and profitability of the traded-goods sector; while domestic demand for imports was pushed up by cheaper foreign products. In addition, a lack of fiscal tightening also contributed to the widening of fiscal deficits in countries like Argentina and Mexico. For example, in Argentina the average ratio of the primary surplus to GDP was -1.2 during 1992–94. The ratio in Mexico seemed to be good, but was argued to be substantially understated (Hemming et al., 2003).

Third, the size of public debt in China over 2008–10 was smaller than that of the other four countries over the 1990s. China's annual debt/GDP ratio was only 15.4 per cent on average; the ratio was highest in Turkey, 40.4 per cent, and was lowest in Brazil, 26.9 per cent. Moreover, while public debt in China is mainly denominated in domestic currency, there was a high portion of external debt in the public sectors of other countries. The cost of debt service in those countries would rise rapidly if the domestic currency depreciated against the foreign currency or the foreign interest rate rose. The cost of debt service in China, on the other hand, is less sensitive to exchange rate volatility, and the cost of borrowing has been maintained at a low level for decades. Thus, while the high debt level and exchange rate peg made those countries more vulnerable to both speculative attacks and higher interest rates, this is less likely in China.

Finally, as Table 3.14 shows, the PBC is the only central bank that could issue its own securities over the selected period. This gives the PBC plenty room for manoeuvre in its monetary policy. Instead of purchasing foreign assets, the central banks in the other four countries had to sell foreign reserves to fix their exchange rates. In order to offset the impact of a declining money supply, the central bank had to purchase the government bonds. Consequently, the upper limit of such sterilized interventions depends on the total amount of government bonds, which is usually not determined by the central bank. Once the foreign reserves are exhausted, or there are not enough government bonds for sterilization purpose (which is exactly the case in China before 2003), the central bank would be unable to maintain the given amount of money supply any longer, and eventually the currency peg would collapse due to

a lower expected return on domestic assets. On the contrary, when the sustainability condition of sterilization is satisfied, the PBC can arbitrarily decide the amount of central bank bills for sterilization purposes and avoid any impact on the monetary base.

In a word, like many other developing countries, all the five countries in Table 3.14 have faced several common fiscal and monetary challenges, and some economic indicators exhibit quite similar patterns. However, a key difference between China at the present time and those developing countries in the 1990s discussed above is that, given their different institutional backgrounds, while the central banks of the latter attempted to fix their exchange rates at an overvalued level, the PBC has been fixing an undervalued exchange rate for decades. In addition, political and economic instabilities in Argentina, Brazil and Mexico caused further falls in the expected return on domestic assets and resulted in an enhanced expectation of depreciation. On the other hand, China's prospective economic growth and its relatively low inflation rate make the Chinese currency increasingly attractive. The conclusion suggested by Canzoneri et al. (2001a), Daniel (2001) and the KFG model states that fiscal dominance would eventually lead to a collapse of a fixed exchange rate. Although this theory has successfully explained the currency crises in some developing countries over the 1990s, we argue that it seems less robust when taking into account a few features exhibited in China's context. Under current circumstances in China, to maintain a credible currency peg in a non-Ricardian regime is plausible. The inconsistency between the monetary policy and the fiscal policy that tends to cause currency crisis is less worrisome.

However, it does not mean that there is no reason to worry about the consequences of the fiscal dominance on the economic stability in China. Note that our conclusions are based on the ground of robust economic growth, modest fiscal deficit, and strong external demand. When China's headlong economic growth starts to slow down while government spending on goods and services starts to increase, the real test will then come. Eventually, either the temptation of the government to print money on a massive scale or the risk of fierce fluctuation of prices would be inevitable. The former would lead to hyperinflation and currency crisis, and the latter is likely to make inflation out of control and trigger serious social unrest in China. A growth engine running out of steam would make China's dilemma over its exchange rate policy no different from that of those developing countries in front of fiscal challenges. Therefore, despite the prestige of fast economic growth the government has gained at present, the sustainability of the fiscal policy and exchange rate policy should be kept in perspective by the authorities just for the rainy day. There's no room for complacency.

3.6 Conclusions

Alexander Hamilton once said: “A national debt, if it is not excessive, will be to us a national blessing.” It has become a consensus that debt policy or, loosely speaking, fiscal policy can affect a nation through different channels. This essay examines the influence of fiscal policy on monetary policy in China since 1980, which has not so far been a cause for concern in the literature on China. The research presents some considerations as follows. First, in order to have a thorough understanding of the fiscal policy, I presented a comprehensive review of the rapid fiscal development over the past sixty years. Against this background, I focused on some specific fiscal issues, for example, the persistent fiscal deficit, the rapid accumulation of the public debt, the pegged exchange rate against the US dollar and its implications for the monetary policy, and so on. All those issues can be regarded as essentially fiscal challenges to the monetary authority’s control over the price level in China.

Second, I conducted an empirical investigation of the fiscal dominance regime for China using a VAR model in the framework of the intertemporal government budget constraint. The estimates show that a positive shock to the primary surplus causes a rise in both future liabilities and future surpluses. Therefore, the primary surplus is an exogenous process, which evolves without regard to the amount of government liabilities. Accordingly, I conclude that the fiscal dominance is empirically plausible in China over 1980–2010. This, in turn, illustrates a constraint that the fiscal policy may impose on monetary policy.

Third, the investigation of the fiscal dominance was extended by considering a pegged exchange rate regime. I discuss a scenario in which there is a sufficient amount of central bank bills, a persistent surplus in both current and capital account, and an expected currency appreciation in the future. The illustration shows that it is theoretically possible to maintain the fixed exchange rate under a fiscal dominance regime. When the primary surplus differs from the current value of real government liabilities at a pegged exchange rate, the central government can accommodate it by adjusting the monetary base through the central bank bills. Given the critical role of central bank bills, I also present a sustainable condition for the PBC’s sterilization operations, which is dependent on the interest rate spread between the US Treasury bonds and the central bank bills. Finally, fundamental differences are displayed between China and countries like Argentina, Brazil, Mexico and Turkey, which support my conclusion that the fiscal dominance regime is less likely to cause a breakdown of the fixed exchange rate in the context of China.

The policy implications of fiscal dominance in China are significant. Since fiscal policy plays a crucial role in the price-level determination, the monetary policy’s impact on inflation, based on the quantity theory of money, would be weakened.

Therefore, price stability requires that the fiscal authority be appropriately disciplined. What China experienced over 2008–10 appears to support this argument in an opposite way, as the accelerated inflation emerged soon after the government’s massive fiscal boost, despite some external pressure on the domestic price level. However, it may be argued that such increasing prices were bid up by higher aggregate demand in the short run because of the huge government spending. Therefore, further analysis is warranted on distinguishing the Keynesian effect from the FTPL on inflation in the context of China after 2009.

The implications of fiscal dominance for the exchange rate policy are critical, too. For a fixed exchange rate regime to be maintained in the presence of huge capital inflows and strong central bank interventions, it does not necessarily require fiscal policy to balance the primary surplus. However, the cost of massively using the central bank bills the PBC is subject to control the monetary base should be noticed.

Further work in examining the underlying interaction between fiscal and monetary policy would seem to be warranted. There are two interesting issues that could be addressed in the context of this essay. First, as central bank bills were not available before 2003, a short sample period imposes constraints on adopting conventional empirical analysis. Alternatively, it would be intriguing to adopt the dynamic, stochastic model simulation strategy. For example, we may examine how the expected dynamic path of government’s total liabilities evolves over time in respect of the amount of central bank bills and interest rate spread between China and the US. Second is the introduction of the government’s contingent liabilities. The government liabilities examined in this essay do not include the contingent liabilities in China, which arise from the non-performing loans (NPLs) in the banks, the state-owned-enterprises (SOEs), and the local government-backed infrastructure investments. Those contingent liabilities, especially when an enormous fiscal stimulus package was launched by the government in the aftermath of the 2008 financial crisis, should be considered in order to ensure sustainable debt service and efficient monetary policy making.

CONCLUSION

Each chapter of the thesis has focused on one aspect of China's monetary policy since the 1980s. The chapters are not mutually independent and have connections with each other. Chapter 1 focused on the monetary policy actions of the central bank in China. The PBC has employed a range of different instruments in the implementation of its monetary policy over the past decades, so no single instrument would constitute an adequate representation of its monetary policy stance. Chapter 1 developed a new policy stance index, and examined it in an ordered probit model, following the studies by Gerlach (2004) and He and Pauwels (2008). The empirical results showed that in a backward-looking model, monetary policy reacted to actual output growth; on the other hand, when deviations from trend levels were considered, the PBC was most concerned with inflation. In a forward-looking model, when we examined the PBC's statements in its quarterly Monetary Policy Executive Report from 2001Q1 to 2010Q3, it seemed that the PBC's assessment of the prospects for inflation played a key role in determining the PBC's monetary policy stance. The results suggested that the PBC was informally targeting inflation, although no explicit target has ever been announced to the public by the PBC. A paper based on this chapter has been accepted by China Economic Review (Xiong, 2011).

Chapter 2 focused on China's monetary conditions and aggregate demand in terms of the MCI, which has been widely used as an important indicator for central banks, financial institutions, and researchers. The MCI is defined as a weighted average of monetary variables (usually the interest rate and the exchange rate) relative to their values in a base period. It can be used to assess the effects of changes in short-term monetary variables on developments in output growth and inflation. The choice of variables and model to derive weights for the MCI is a key issue. To construct such an MCI in the context of China over 1987Q1–2010Q2, Chapter 2 con-

sidered three channels through which monetary conditions might influence aggregate demand: the primary lending rate, the real effective exchange rate, and bank credit. The weights of the component variables were obtained by estimating both the IS equation and the vector autoregressive model (VAR). The two approaches yielded somewhat similar results. In terms of the effects on the real GDP growth rate, in the IS-based model (VAR-based model), a 1 percentage point increase in the real interest rate has about the same effects as a 1.90 per cent (1.13 per cent) increase in the real effective exchange rate, and as a 0.46 per cent (0.10 per cent) decrease in the new bank credit/GDP ratio. Empirical tests showed that the MCIs we derived contained useful information about future output growth and inflation in China over the short and medium term. From a historical perspective, the MCI is informative for the understanding of the development of China's monetary conditions between 1987 and 2010.

Chapter 3 examined China's monetary policy in a wider perspective. According to the Fiscal Theory of the Price Level (FTPL), fiscal policy plays a crucial role in price-level determination. Thus, price stability requires that the fiscal authority be appropriately disciplined. Chapter 3 examined the fiscal challenges to the monetary authority's control over the price level in China. An empirical investigation of the extent of fiscal dominance was conducted using a VAR model in the framework of the intertemporal government budget constraint. The empirical result suggested a fiscal dominance regime in China over 1980–2010. This implication of fiscal dominance for price determination is crucial for China's monetary policy aimed at curbing inflation, especially in the aftermath of the government's massive fiscal stimulus package during 2008–2010. The chapter then considered a pegged exchange rate regime and discussed a scenario with central bank bills, current and capital account surpluses, and an expected currency appreciation. It shows that in China over recent years the balance of payments surplus has been much larger than the budget deficit, as a source of potential monetary growth. It then argued that theoretically it is possible to maintain the fixed exchange rate under a fiscal dominance regime. For a fixed exchange rate regime to be maintained in the presence of large capital inflows and strong central bank interventions, the fiscal authority is able to raise seigniorage revenue to balance the government budget constraint, while the monetary authority needs not to worry about the foreign exchange reserves to decrease.

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CHAPTER 1

A.1 Policy change index: 1986Q4–2010Q3 (alternative index, regardless the evolution of policy instruments)

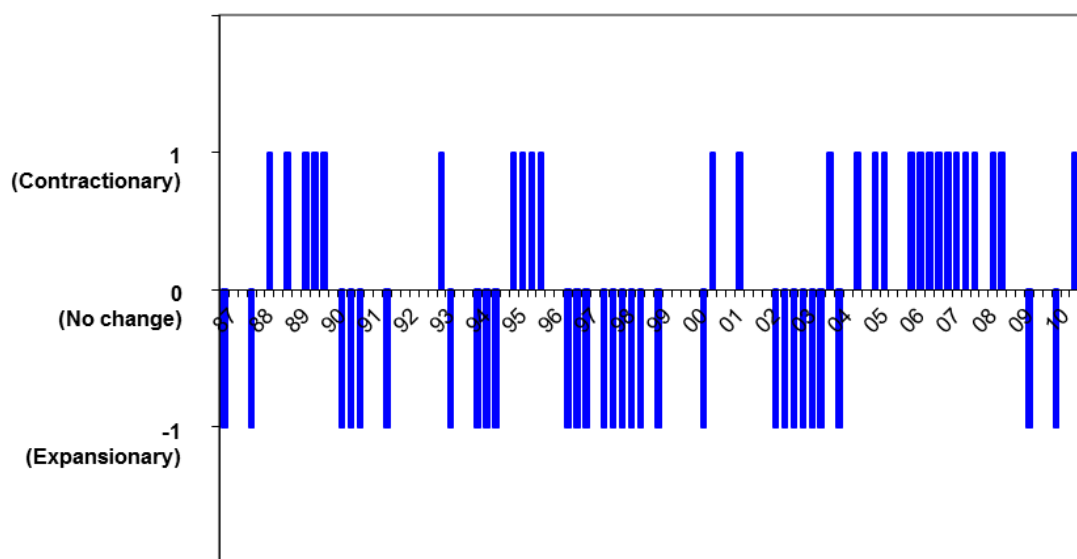


Figure A.1: Policy change index

A.2 Real activity indicator

Table A.1: Real activity indicator

Dates	Real activity	In the Quarterly Report	Page
2001Q1	-1	In the first quarter, the macro economy keeps on growing steadily, which is consistent with the growth trend of the previous year. ... China has to carry on a policy of stimulating domestic demand ... and consolidate the positive trend of national economic development.	8; 23
2001Q2	-1	From the beginning of this year, China is sticking to a stimulus of the macro economy aiming at enlarging domestic demand and offsetting the negative effect of the global economic slowdown The economic growth is relatively steady in the first half of this year.	7
2001Q3	-1	The industrial production growth slows down, and the profit growth fall emerges. ... Both of the imports and exports growth decrease, particularly, the exports are facing a tough situation.	10
2001Q4	-1	Throughout the year 2001, the external situation of China's economic growth is severe. ... The central government follows the strategy of enlarging the domestic demands, and goes on with implementing an active fiscal policy as well as a moderate monetary policy, ...	6
2002Q1	0	The national economic growth is satisfied.	3
2002Q2	0	The national economic growth is continuously at a rapid pace.	3
2002Q3	0	The national economic growth is continuously at a rapid pace.	8
2002Q4	0	The economic growth is increasing over seasons.	17
2003Q1	0	In the first quarter of this year, the national economy has a good beginning.	1
2003Q2	0	... China has overcome the negative impacts of the Iraq War and SARS (Severe Acute Respiratory Syndrome), and maintained a positive trend of economic growth.	13
Continued on next page			

Table A.1 – continued from previous page

Dates	Real activity	In the Quarterly Report	Page
2003Q3	1	The sharp increase of the fixed assets investments are the main driving force of the rapid economic growth. ... Under the circumstance of the insufficient demand and oversupply of the semi-finished products, the situation may go worse if money and credit growth are not controlled.	16;18
2003Q4	1	...but there are some problems and conflicts during the process of the fast economic growth, which are not good for a sustainable and healthy development of the economy and financial industry. Some of the industries have a serious problem of duplication constructions of similar projects; the industries of energy and transportation have encountered a 'bottle-neck' restriction which has been seldom seen for many years, ...	12; 13
2004Q1	1	In the first quarter of this year, China's economy grows rapidly, but the fixed assets investments increase too fast, and the problem of which is not solved effectively. ... Firm quantitative tightening measures must be taken to cool down the overheating of the fixed assets investment.	1;13
2004Q2	1	The demand for investments which is growing too fast is held back initially, while the demand for consumption is still strong.	26
2004Q3	1	However, many problems and conflicts still remain in the national economic life, the agricultural foundation is not consolidated yet, and the size of the fixed assets investments is still too large.	27
2004Q4	1	Although China's economy is moving towards the targets of macroeconomic control, there still remain many problems and conflicts, the agricultural foundation is not consolidated yet, and the pressure of the fixed assets investments rebound is quite large.	34
Continued on next page			

Table A.1 – continued from previous page

Dates	Real activity	In the Quarterly Report	Page
2005Q1	1	... the national economy grows rapidly and smoothly. ... But the size of the fixed assets investments is still too big; the supply of coal, electricity and oil is insufficient; CPI figure falls but the inflationary pressure is remaining.	23
2005Q2	1	... the effects of the macroeconomic control emerge, and the national economy grows rapidly and smoothly. ... But the size of the fixed assets investments is still too big; constraints of resources and energy are obvious. Meanwhile, the profits fall in some industries, the growth of exports decreases, trade frictions become more serious.	27
2005Q3	1	... the national economy keeps on growing rapidly and steadily, ... but the size of the fixed assets investments is still too big; the disequilibrium of imports and exports is worsen; the structure of exporting is unreasonable.	31
2005Q4	1	... but the pressure of the fixed assets investments rebound is quite large, and the balance of payments is not balanced.	30
2006Q1	1	But the fixed assets investments grow too fast; the structure of exporting is unreasonable.	28
2006Q2	1	However, the fixed assets investments grow too fast; the money and credit supply is too much; the disequilibrium of balance of payments is worsen; the energy consuming is too much; the environment problem becomes more severe.	30
2006Q3	1	However, the foundation of a fixed assets investments falling is not consolidated; the disequilibrium of balance of payments is worsen; income growth for the farmers becomes more difficult; the problem of energy saving and pollution are quite severe.	27
Continued on next page			

Table A.1 – continued from previous page

Dates	Real activity	In the Quarterly Report	Page
2006Q4	1	...generally speaking, the overall economic growth is good. The demand for consumption increases fast; the growth of fixed assets investments eases up at a relatively high level, ... but the relationship of investment and consumption is still unreasonable, the pattern of economic growth is extensive; the disequilibrium of balance of payments is worsen ; the problem of energy saving and pollution are quite severe.	28
2007Q1	1	...the national economy keeps on growing rapidly and steadily, ...the size of fixed assets investments is too large, and the growth is still strong.	29;30
2007Q2	1	...the national economy keeps on growing rapidly and steadily, and the general situation of the economy is good. ... The structure of the fixed assets investments is improved, but the growing pace is still fast, with an upward pressure of rebound. ...the growth of exports is faster than that of the imports, and the trade surplus is continuously enlarging.	33;34
2007Q3	1	The growth of consumptions in cities and towns is increasing; the growth of investment remains at a high level; the trade surplus is enlarging. ...the growth of fixed assets investment falls, but is still at a high level.	31;32
2007Q4	1	The consumption grows rapidly; the investments remain at a high level; the trade surplus is enlarging.	33
2008Q1	0	In the first quarter of 2008, in spite of the tough international economic environment and the severe disaster of the snow storm, the economic growth remains quite stable, which is better than expected.	31
2008Q2	0	...the national economy has a stable and rapid growth; ...the economy is growing towards the intended direction of the macro control.	34
2008Q3	0	The national economy remains a stable, rapid growth ... the growing trend of the economy is not affected by the international financial crisis and natural disaster.	30
Continued on next page			

Table A.1 – continued from previous page

Dates	Real activity	In the Quarterly Report	Page
2008Q4	-1	The shocks of the global economic and financial crisis impose an increasing downward pressure on the national economic growth.	35
2009Q1	-1	Currently, the global financial crisis is spreading which has a deepening impact on China's economy...the downward pressure on the economic growth is considerable.	2,32
2009Q2	-1	China's economic development is now at a critical period of the recovery, we are facing lots of difficulties and challenges; the foundation of the recovery is not solid, and there are also lots of uncertainties from abroad.	2
2009Q3	-1	The trend of economic recovery is still on the way... The economic development is now at a critical period of the recovery, we are facing many difficulties and challenges	1,2
2009Q4	0	Although there are uncertainties, generally speaking the external environment of our economy is now improving.	50
2010Q1	0	In the first quarter of 2010, China's economy has a very good start, the recovery is strengthened. Domestic demand keeps a rapid growth, foreign trade and industrial production are recovering quickly, consumption is also growing rapidly.	1
2010Q2	0	China's economy is moving towards the target, and the overall growth is good.	1
2010Q3	0	In the third quarter of 2010, China's economy is moving towards its target, the recovery is strengthened. Since August the economic growth is steady.	1, 50

A.3 Inflation indicator

Table A.2: Inflation indication

Dates	Inflation Indicator	In the Quarterly Report	Page
2001Q1	0	The market price recovers slightly; a sharp increase of the price within the year seems to be impossible.	10;23
2001Q2	0	The price recovers slowly, with a small magnitude. The possibility of inflation is relatively tiny.	9
2001Q3	-1	...currently the insufficient market demand is the main reason of the low prices, the conflict of the excess supply is prominent. ... The current situation of the low prices is hard to be changed in a short period; the upward pressure on the price level will decrease in the following months.	13
2001Q4	0	China's market prices go smoothly.	6
2002Q1	-1	The market prices are still at a low position.	4; 5
2002Q2	-1	In a word, the current price falling is mainly due to the excess production capability as well as a slow down of the effective demand growth, which reflects a profound structural conflict in the economy.	5
2002Q3	-1	Hence, taking it as a whole, either the CPI or the enterprise commodity index decreases compared to the same period of last year, but the speed of decreasing is slow, while the month-on-month increase recovers slowly.	9
2002Q4	-1	The continuous low market prices not only have certain impacts on the current economic benefits of the firms, but also reduce the expectations of the producers, investors and consumers.	17
2003Q1	0	The deflation pressure which has disturbed China's economic development is eased. ... Taking into consideration both the upward and downward pressure on prices, the overall price level will keep on increasing.	14; 15
Continued on next page			

Table A.2 – continued from previous page

Dates	Inflation Indicator	In the Quarterly Report	Page
2003Q2	0	From the fundamental perspective of the economy, the rapid growth of the demand for investments and large increase of the money and credit are the main reasons for this year's price rising, but such rising is subject to many constraints and hence the magnitude will not be very large.	16
2003Q3	1	Currently, the prices of manufacturing, fixed assets investments and real estate are recovering rapidly; asset prices climbing at an excessive speed which may result in asset bubbles should be avoided.	18
2003Q4	1	The inflationary pressure is becoming larger, which needs to be paid close attention to. ... After September 2003, prices increase sharply due to the emerged bottleneck in the industry of raw materials and energies.	14
2004Q1	1	... the inflationary pressure is huge ...	1
2004Q2	1	CPI keeps on climbing rapidly.	29
2004Q3	1	There has been no clear easing of the inflationary pressure so far.	30
2004Q4	1	The inflationary pressure has not been eased fundamentally.	34
2005Q1	1	The inflationary pressure is still worth paying close attention to.	27
2005Q2	0	All kinds of price indices fall steadily.	34
2005Q3	1	All kinds of price indices fall steadily on a month-on-month basis. However, there remains an inflationary pressure.	35
2005Q4	1	Although CPI goes in a low position, The inflationary pressure is still worth paying close attention to.	36
2006Q1	0	The market prices are stable. ... All the price indices fall steadily.	28;30
2006Q2	1	All kinds of the prices are basically remaining stable, but the inflationary pressure is growing bigger and bigger.	33
2006Q3	1	The price level is stable with a slight upward trend; there still exists an inflationary pressure.	31
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Table A.2 – continued from previous page

Dates	Inflation Indicator	In the Quarterly Report	Page
2006Q4	1	... but in the second half of this year there has been an upward pressure on the price level; the future price rising becomes more likely, the objective of price stability encounters a potential pressure.	30; 41
2007Q1	1	The amount of CPI increase is rising. ... Food price rising ... is the main reason of the CPI increasing; The prices in the real estate market also play an important role in pushing up the CPI.	32
2007Q2	1	The inflationary pressure is continuously growing.	35
2007Q3	1	The inflationary pressure is growing further.	33
2007Q4	1	The amount of CPI increase goes up rapidly. ... The amount of the industrial production price increase exhibits an enlarging tendency. ... Both the importing and exporting price rise rapidly, whereas the amount of increase of the former exceeds that of the latter.	35; 36
2008Q1	1	The CPI inflation grows fast on a relatively high level. ... Inflationary pressure is still quite high.	35; 47
2008Q2	1	CPI growth declines a bit from a high level, but the inflationary pressure remains quite big. ... The situation of the inflation should be regarded seriously.	37; 48
2008Q3	0	CPI inflation keeps on decreasing. ... the inflationary pressure is released to some extent.	33; 35
2008Q4	-1	Based on the trends of the price movements, there is a downward pressure on the price level.	51
2009Q1	0	Affected by the base period, CPI is decreasing compared with the same period of previous year. ... the influence from base period is greater than that of the current price rising.	34
2009Q2	0	CPI is decreasing compared with the same period of previous year, but when excluding the seasonal effects and other random effects, price level stops falling in terms of sequential growth rate.	38
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Table A.2 – continued from previous page

Dates	Inflation Indicator	In the Quarterly Report	Page
2009Q3	0	The impact of base period on price rise is reducing... attention should be paid to deal with the relationship between economic growth and avoiding financial risks, and inflation expectation should be well managed.	36; 44
2009Q4	0	As long as the trend of economic recovery is certain, prices of international commodities are continuously rising, the impact of base period on price rise is reducing.	41
2010Q1	1	The aggregate price level is basically stable... those factors pushing up the price level are emerging, which increase the expectation of inflation... The influence from base period is less than that of the current price rising.	1; 2; 37
2010Q2	1	The condition of prices is quite complicated, we should improve the management of inflation expectation... Consumer prices are rising gently.	3; 39
2010Q3	1	The uncertainties of future prices are large, we should improve the management of inflation expectation.	2; 50

A.4 Money indicator

Table A.3: Money indicator

Dates	Money Indicator	In the Quarterly Report	Page
2001Q1	0	The aggregate money supply is generally appropriate; ... the enterprises demands for capital are basically supplied.	5
2001Q2	0	The growth of the money supply is moderate, which meets the needs of the economic development.	1
2001Q3	0	The increase of money supply is slowing down, but such increase, nevertheless, basically suits the economic development.	1
2001Q4	-1	(the money supply)... returns to normal in the fourth quarter due to the implementations of various monetary policy instruments.	2
2002Q1	0	The money supply grows smoothly.	1
2002Q2	0	The money supply and credit grow smoothly.	1
2002Q3	-1	The money supply grows at an increasing pace, which provides more supports to the economic growth.	1
2002Q4	-1	... The broad money, M2, and the narrowly defined money, M1, are having an increasing growth over months, which reflect an endogenous demand of the economic recovery for money growth, and reflect increasing supports to the economic growth. The money and credit supply are fundamentally consistent with the speed and trend of the economic growth.	1
2003Q1	1	The growth of money supply is accelerating markedly. ... The growth of the loan by the financial institutions increases largely. ... The deposits at the financial institutions increase a lot, the savings deposits by the households increase at a high speed.	1
2003Q2	1	The growth of the broad money M2 ... exceeds the sum of the growth of GDP and CPI by 12 percent. The M2 growth is at its highest level since 1998.	1
2003Q3	1	The money supply keeps growing rapidly. ... The loan growth granted by the financial institutions is still too fast.	1
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Table A.3 – continued from previous page

Dates	Money Indicator	In the Quarterly Report	Page
2003Q4	1	In all, the growth of money and credit, which expanded too fast in the first half of the year, is under control in the fourth quarter; the exchange rate is stable, and the financial industry is running smoothly.	1
2004Q1	1	...the inflows of the foreign exchange are continuously increasing; the growth of money and credit is too fast; the task of financial control becomes very difficult.	1
2004Q2	0	The effects of the financial control are visible; the growth of money and credit supply fall over seasons; the exchange rate is stable, and the financial industry is running smoothly.	1
2004Q3	0	The growth of the money and credit are moderate; the structure of the credit is improved. The money and credit supply are running towards the targets of the financial control.	1
2004Q4	0	From August to December, M2 growth is at the range of 13% and 15%, which is quite appropriate and is consistent with the economic growth.	1
2005Q1	0	Since the enhancement and improvement of the macro control, the growth of the broad money, M2, has been kept at 13%-15% for eight months, which generally suits the economic growth.	1
2005Q2	0	To the end of June, M2 has been stable for three months with a recovery trend, which generally meets the requirement of a smooth economic growth.	1
2005Q3	0	The growth of aggregate money supply is increasing; the growth of the loans granted by the financial institutions is stable; the structure of the credit is improved. All of these generally meet the requirement of the macro control.	1
2005Q4	0	The growth of the money and credit are moderate; the structure of the credit is improved. All of these generally meet the requirement of the macro control.	1
Continued on next page			

Table A.3 – continued from previous page

Dates	Money Indicator	In the Quarterly Report	Page
2006Q1	1	...the financial industry is running smoothly as a whole, while the growth of the money and credit exceed the expected target.	1
2006Q2	1	...the growth of money supply is quite large; the size of the credit increases a lot; the financial industry is running smoothly as a whole.	1
2006Q3	0	The increase of the money and credit supply is decreasing, which generally meets the requirement of the macro control; the financial industry is running smoothly as a whole. ...It is the slow down of the loans supply which results in a fall of M2 increase.	1
2006Q4	0	The trend of the fast increasing growth of money and credit is depressed, which generally meets the requirement of the macro control.	1
2007Q1	1	By implementing various measures of the macro control, there are marked decreases of the money and credit growth, however as a whole, the growths are still too fast.	1
2007Q2	1	To aim at the problem of rapid growth of the liquidity in the banking system, as well as the pressure of the money and credit expanding, the PBC follows closely the orders of the central government and the State Council to carry out a series of measures which enhance the macro financial control and keep the balance of the aggregate size. ...The money supply is still running at a high position, but the trend of a too fast growing is depressed to some extent.	1
2007Q3	1	the financial industry is running smoothly as a whole, but the pressure of the money and credit expanding is still quite big, ...the growth of loans is quite fast. ...The money supply is still growing too fast.	1
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Table A.3 – continued from previous page

Dates	Money Indicator	In the Quarterly Report	Page
2007Q4	1	By implementing various measures of the macro control, the trend of a too fast growing of money and credit are depressed to some extent, but the expanding pressure is still big. ... At the year end, the M1 growth is 4.3 percent higher than the M2 growth, which reflects an increasing liquidity within the banking system.	1
2008Q1	1	... the pressure from fixed assets investments is still high, ... there is much more excessive liquidity, the foundation for a decline of money and credit growth is not consolidate yet.	48
2008Q2	0	The growth of money supply declines a bit. ... M2 supply keeps a stable growth rate.	1
2008Q3	0	The growth of money supply is steady. ... The liquidity in the financial system is sufficient.	1; 5
2008Q4	-1	Since September, there is an increasing shock from the international financial crisis to the national economic growth, the PBC implements a moderately loose monetary policy according to the arrangement of the central government and the State council. ... to assure a sufficient supply of the liquidity in the banking system.	8; 9; 10
2009Q1	0	The liquidities in the banking system are sufficient, money and credit grow rapidly, and the overall financial system is running steadily.	1
2009Q2	0	The moderately expansionary monetary policy is effectively transmitted. The growth of money supply and credit provides important supports to rebuild market confidence, and to a rapid economic growth.	1
2009Q3	0	In general, the rapid growth of money supply and credit support the economic recovery to a great extent.	1
2009Q4	1	Through the efforts, the rapid credit growth is slowing down, which is helpful to avoid any risks to the long-term economic growth.	1
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Table A.3 – continued from previous page

Dates	Money Indicator	In the Quarterly Report	Page
2010Q1	1	The growth of money supply and credit are on their way back to a normal level	1
2010Q2	1	The growth of money supply and credit are on their way from a high level of last year back to a normal level.	1
2010Q3	1	According to the requirement of the situation, the growth of money supply should be pulled back to normal gradually.	2